ENGINEERING

An Illustrated Weekly Journal

35 & [illegible] BEDFORD STREET, STRAND, LONDON, W.C.2 - - TELEPHONE: TEMPLE BAR 3663

Vol. 181 No. [illegible] *LONDON, FRIDAY, FEBRUARY* 3, 1956 PRICE 2s.

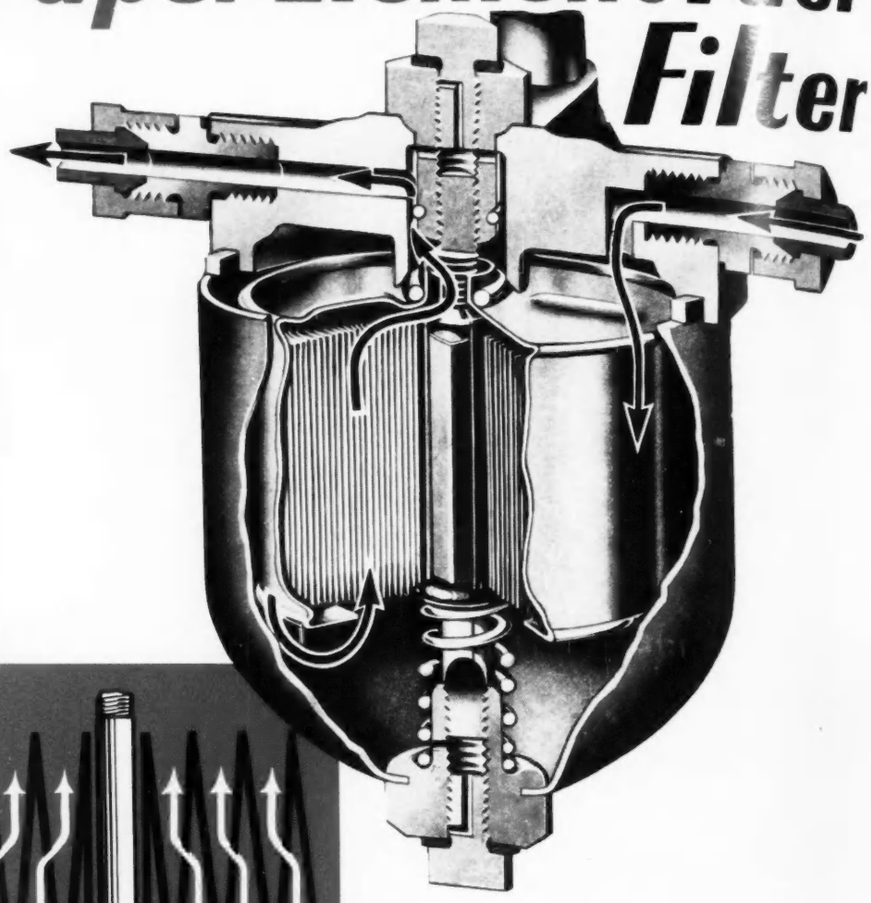
[illegible]ING A SUPERHEATER HEADER

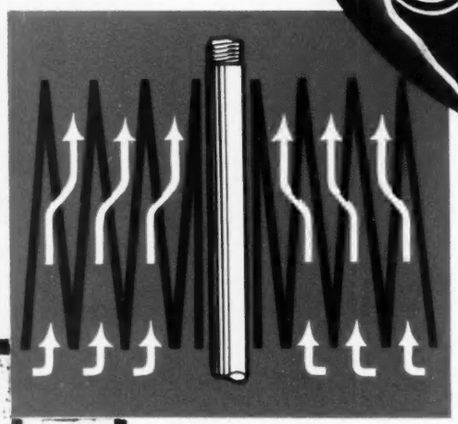
New C.A.V. Paper Element Fuel Filter

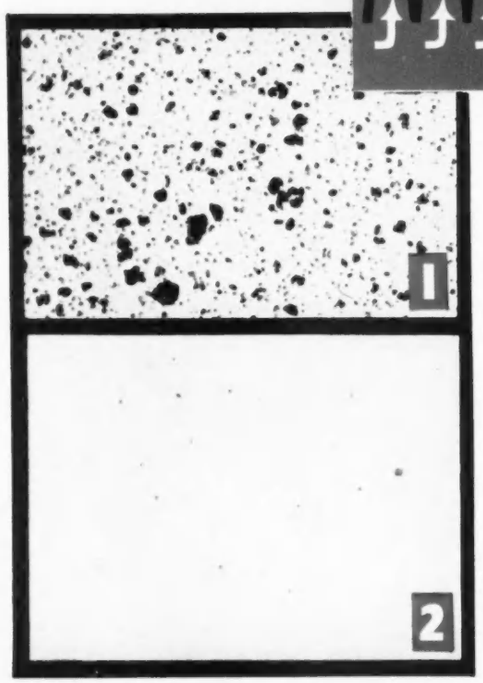
Greater Filter area

Highest efficiency

Minimises wear on injection equipment







Clean fuel gives up to 8 times pump life

Research shows that fuel pump and injector wear are largely caused by fine, abrasive dust carried in the fuel, and that if fuel is clean, pump wear is negligible. The new C.A.V. type 'F' filter with the spiral vee-form paper element is designed to remove the minute particles from fuel, that will entirely escape an ordinary filter. The photomicrographs show (1) fuel as supplied (approx. by 100), and (2) the fuel after filtering with the new element (to same scale).

The centre illustration shows diagrammatically the principle of the spiral vee-form element, and the path taken by the fuel. Note the large filtering area, 560 sq. inches in all, many times that of most filters; yet the new filter is only two-thirds the size of the corresponding cloth or felt filter.

Exhaustive field tests show the new filter gives up to eight times the injection equipment life by eliminating rapid wear.

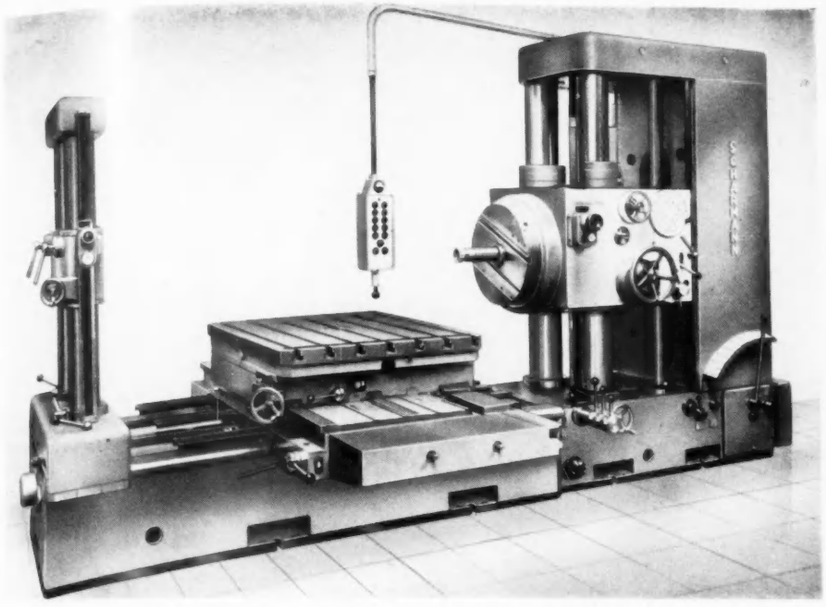
LOW INITIAL COST. CHEAP TO MAINTAIN GREATLY REDUCES OVERHAUL COSTS

The World's Leading Manufacturers of

FUEL INJECTION EQUIPMENT

C.A.V. LIMITED, ACTON, LONDON, W.3

AP 1714/20



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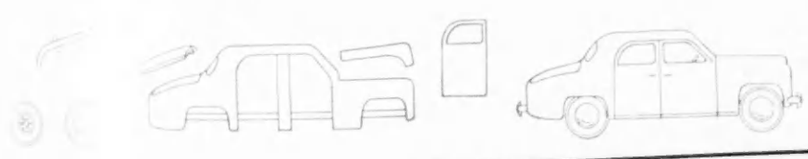
or assemble refrigerators?*

or make a lot of motor cars?*



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TAS/CK. 587

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Many of the nation's major power stations depend upon sluice and reflux valves supplied by Sir W. H. Bailey & Company Limited. Backed by more than a century's experience the company provides a standard range of high quality valves from 2 to 54-inch bore for pressures up to 150 p.s.i. Advice is gladly given on any special purpose applications and a Special Contracts Department is maintained to deal with valve schedules on large contracts anywhere in the world.

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54-inch Bailey's Sluice valve installed at Hardingstone Power Station. Two 39-inch, four 42-inch and two 54-inch sluice valves were supplied by Bailey's for this contract. They are designed for operation by both local and remote control.

A 54-inch Bailey Check valve specified for Thornhill Power Station.

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CLASSIFIED ADVERTISEMENTS SECTION.

For all advertisements classified under the headings of Tenders, Appointments Open, Situations Wanted, Patent Agents, Partnerships, Wanted, &c., Auction Sales, Publications For Sale, Miscellaneous and Public Notices, &c., the charge will be **12s.** for the first four lines or under and **3s.** per line up to one inch. When an advertisement measures an inch or more, the charge will be at the rate of **36s.** per inch. 5% allowed on 6, 10% on 13, 15% on 26 and 20% on 52 Weekly insertions. If use is made of a box number the extra charge is **2s.** per insertion with the exception of advertisements appearing under Situations Wanted. Prospectuses and Notices of Company Meetings £25 per column. Copy instructions must be in our hands first post Monday for the following Friday's issue. Address to the Manager, ENGINEERING LTD., 35 and 36, Bedford St., Strand, W.C.2 Inclusion of advertisements must be dependent on space being available.

EDUCATIONAL.

FREE. Brochure giving details of courses in Mechanical and Production Engineering, Draughtsmanship, etc., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other Professional examinations. **B.M.I.** INSTITUTES, DEPT. EG. 30, LONDON, W.4. (ASSOCIATED WITH H.M.V.). G 619

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DETECTION AS USED BY WATER-DIVINERS now has many well-checked applications in the laboratory and the home; time-saving assessments. Ability Test free from A-A-P POSTAL COURSES (EG), STOCK, ESSEX. (ESTD. 1938). K 148

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SOMERSET EDUCATION COMMITTEE.

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For students with graduate or Higher National Certificate qualifications. Inclusive fee for each course £7 7s. 0d. Final enrolment 14 days before course begins. Details from the WARDEN, DILLINGTON HOUSE, COLLEGE FOR ADULT EDUCATION, ILMINSTER, SOMSERSET. K 238

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TEAM OF DESIGNERS available for Mechanical and Production Engineering Special Machines and Projects. NORRIS BROTHERS, LTD., 53, Victoria Street, London, S.W.1. Tel.: Abbey 5444. G 530

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RESEARCH ENGINEERS LIMITED,

Northampton Grove, Canonbury, London, N.1. Canonbury 4244/5/6. We have over 25 years' experience of experimental work and prototypes. We design, develop and manufacture special purpose and labour saving machines, all at the above address. Our range is from the smallest scientific instruments to 3- or 4-ton machines. After a prototype machine has been made and found satisfactory we can manufacture as many as are required in our Works. G 656

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LATTICE STEEL ERECTION MASTS (light and heavy) 30 ft. to 150 ft. high, for immediate hire.—BELLMAN'S, 21, Hobart House, Grosvenor Place, S.W.1. G 72

TENDERS.

COUNTY BOROUGH OF GRIMSBY.

EDUCATION COMMITTEE.

TENDERS are invited for the supply of **CERTAIN EQUIPMENT REQUIRED FOR THE HIGH NATIONAL CERTIFICATE COURSE IN MECHANICAL ENGINEERING** at the Grimsby College of Further Education. Details may be obtained upon application to this office.

When completed, tenders should be delivered to the undersigned, in the envelope which will be provided, not later than 10.0 a.m. on Saturday, the 11th February, 1956.

The Authority does not bind itself to accept the lowest or any tender.

R. E. RICHARDSON,
DIRECTOR OF EDUCATION.

EDUCATION OFFICE,
ELEANOR STREET,
GRIMSBY. K 176

GOVERNMENT OF IRAQ.

DEVELOPMENT BOARD AND MINISTRY OF DEVELOPMENT.

NASIRIYAH ROAD BRIDGE
CONTRACT B/8 (1956)

THE DEVELOPMENT BOARD AND MINISTRY OF DEVELOPMENT invites **TENDERS** from experienced Civil Engineering Contractors for the construction of a **STEEL CANTILEVER ROAD BRIDGE** approximately 180 metres long and 11 metres wide over the River Euphrates at Nasiriyah, together with the **STEEL AND REINFORCED CONCRETE APPROACH VIADUCTS** and embankments thereto.

The Contract Documents and Conditions as to Tendering may be inspected on and after the 17th day of January, 1956, at any of the following places:—

(*a*) The offices of the DIRECTORATE GENERAL OF LEGAL AFFAIRS AND CONTRACTS, MINISTRY OF DEVELOPMENT, BAGHDAD, IRAQ.
(*b*) THE EMBASSIES AND LEGATIONS OF IRAQ IN WASHINGTON, PARIS, ROME, BRUSSELS, BONN, CAIRO, KARACHI AND NEW DELHI.
(*c*) The offices of RENDEL, PALMER & TRITTON, 125, VICTORIA STREET, LONDON, S.W.1, ENGLAND.

Firms desiring to Tender may obtain two copies of the Contract Documents between the 17th day of January, 1956, and the 17th day of March, 1956 (both days inclusive) from the DIRECTORATE GENERAL OF LEGAL AFFAIRS AND CONTRACTS, MINISTRY OF DEVELOPMENT IN BAGHDAD, or the offices of RENDEL, PALMER & TRITTON IN LONDON, upon payment of twenty-five Iraqi Dinars or the equivalent thereof for each two sets of documents.

Tenders must be accompanied by a deposit of I.D. 10,000/- (Ten thousand Iraqi Dinars) either in cash or by a letter of guarantee to be made by or through an approved Bank established in Iraq. Fully detailed conditions as to this deposit may be ascertained from the "Conditions of Tender" attached to the Contract Documents.

Tenders must be submitted to the DEVELOPMENT BOARD (DIRECTORATE GENERAL OF LEGAL AFFAIRS AND CONTRACTS, MINISTRY OF DEVELOPMENT), BAGHDAD, IRAQ, in sealed envelopes endorsed clearly on the outside with the words "NASIRIYAH ROAD BRIDGE," and will be received up to noon on the 17th day of April, 1956.

A Memorandum of Capacity, Method of Procedure and Articles of Association must be submitted at the same time.

Particular attention is drawn to Clause 8 of the "Conditions of Tender" stating that tenders will be accepted only from firms of Contractors who have previously executed works of a similar character and magnitude.

Tenders not submitted within the time specified or not accompanied by a receipt of the deposit, or a letter of guarantee or if the Tenderer resides in a Liwa in Iraq where a Chamber of Commerce exists, by a Certificate of Membership of a Chamber of Commerce, shall be neglected.

The Board does not bind itself to accept the lowest or any Tender.

MINISTER OF DEVELOPMENT. J 737

PUBLIC APPOINTMENTS.

ADMIRALTY.
ROYAL NAVAL SCIENTIFIC SERVICE.

ENGINEERS AND PHYSICISTS (PARTICULARLY WITH ELECTRONICS) required in Experimental Officer and Assistant Experimental Officer grades in Experimental Establishments in London, Portsmouth, Weymouth areas, Gloucestershire and Scotland. Qualifications: British subjects, minimum of H.S.C. (Pass degree, H.N.C. or near equivalent an advantage). London salary (men), E.O. £790-£960, A.E.O. £320 10s.-£700 (according to age). Appointments unestablished but opportunities to compete for established posts.—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting A214/5A. J 724

LONDON COUNTY COUNCIL.

ARCHITECT'S DEPARTMENT.

Vacancies for
ENGINEERING ASSISTANTS (up to £783) and Engineer Grade III (up to £945) in the Structural Engineering Division. Work includes steelwork and reinforced-concrete design and detailing for Council's buildings. Particulars and application forms from Architect (AR/EK/SE/1), THE COUNTY HALL, S.E.1. (1273). G 573

RAILWAY WORKSHOP FOREMAN required for West of India Portuguese Guaranteed Railway (British Company, London) in Goa. Candidates must have served full apprenticeship plus further experience in Railway or Loco. Builders erecting shop and running shed. Salary up to £1250 depending on experience. Initial tour 2 years.—Applicants to send details experience to SIR BRUCE WHITE, WOLFE, BARRY & PARTNERS, CONSULTING ENGINEERS, 1, LYGON PLACE, S.W.1. SLOane 0431. K 239

SWINDON EDUCATION COMMITTEE.

THE COLLEGE.

(PRINCIPAL: W. GILLESPIE, M.Eng., B.Sc.)

Applications are invited for the undermentioned appointments:—

ENGINEERING DEPARTMENT—

GRADE "B" ASSISTANT FOR MECHANICAL ENGINEERING.
GRADE "B" ASSISTANT FOR PRODUCTION ENGINEERING.
GRADE "B" ASSISTANT FOR MATHEMATICS AND SCIENCE (TO ADV. G.C.E.).

Applicants should be graduates or have equivalent qualifications, with industrial and/or teaching experience.

Forms of application, together with further particulars, may be obtained from the undersigned upon receipt of a stamped addressed foolscap envelope. Completed forms should be returned to the Education Department, Civic Offices, Swindon, within 14 days of the appearance of this advertisement.

G. JELLICOE,
BOROUGH EDUCATION OFFICER.
K 177

MANCHESTER CORPORATION WATER-WORKS.

Applications are invited for the undermentioned engineering appointments on the temporary staff of the Corporation in connection with the design and execution of works included in the Third Instalment of the Haweswater Scheme, consisting of the second line of 54 inch steel pipes, and two service reservoirs (200 million gallons capacity) near Bury, Lancs. The construction of the works is expected to extend over about 3 to 5 years.

ASSISTANT ENGINEERS (CLASS II)—Salary in the range of £795 to £970 p.a., according to qualifications and experience.

ASSISTANT ENGINEERS (CLASS III)—Salary in the range of £640 to £765 p.a., according to qualifications and experience.

Housing accommodation at a reasonable rental will be provided for Assistant Engineers (Class II) and in certain cases for Assistant Engineers (Class III).

Applications stating (1) age, (2) education and training, (3) professional qualifications, (4) experience in the preparation of plans and construction of Waterworks or other Civil Engineering works, also indicating the class of appointment applied for, must be accompanied by the names of two referees and addressed to the ENGINEER AND MANAGER, WATERWORKS OFFICES, TOWN HALL, MANCHESTER, 2, endorsed "Application for Temporary Engineering Appointment," so as to be received by the 10th February, 1956. K 189

BELFAST EDUCATION COMMITTEE.

COLLEGE OF TECHNOLOGY.
Principal: D. H. ALEXANDER, O.B.E., M.Sc. (Cantab.), M.I.Mech.E.

APPLICATIONS are invited for the position of **SENIOR LECTURER IN THE BUILDING DEPARTMENT** of the College.

Candidates should preferably hold an honours degree, with civil or structural engineering as the main subject, and it is desirable that they should be corporate members of The Institution of Civil Engineers or The Institution of Structural Engineers.

Further particulars and form of application may be obtained from the PRINCIPAL, COLLEGE OF TECHNOLOGY, BELFAST, with whom applications must be lodged not later than Tuesday, 31st January, 1956.

J. STUART HAWNT,
DIRECTOR OF EDUCATION. K 240

CAIRO UNIVERSITY.

FACULTY OF ENGINEERING,
GIZA, EGYPT.

Applications are invited for the post of **PROFESSOR OF PETROLEUM ENGINEERING (PROSPECTING AND PRODUCTION)** at the Faculty of Engineering, Cairo University, Egypt.

Candidates must possess a Ph.D. Degree in Petroleum Engineering, and should be capable of delivering lectures in English.

Appointment shall be by contract for two calendar years renewable thereafter for five years if desired. Salary offered from £E900 to £E1500 basic, plus £E360 expatriation allowance and £E75 high cost of living allowance per annum. Higher basic salaries may be considered if cases of outstanding qualifications.

Full particulars of age, academic qualifications, engineering and teaching experience, recent scientific and engineering contributions and publications should reach the DEAN OF THE FACULTY by registered mail before 1st March, 1956. K 190

WOLVERHAMPTON AND STAFFORDSHIRE TECHNICAL COLLEGE.
Principal: C. L. OLD, B.Sc. (Eng.), M.Sc.Tech.

Applications invited for **LECTURER IN DEPARTMENT OF PRODUCTION ENGINEERING AND MANAGEMENT,** mainly for technical management subjects in B.M. courses. Ability to assist with H.N.C. and sandwich courses an advantage. Candidates must hold a degree and/or equivalent professional qualification with appropriate industrial experience. **GRADE B ASSISTANT** to teach metal working processes and practice in City & Guilds and National Certificate courses. Aptitude for machine tool demonstration. Industrial experience with possession of Full Technological Certificate in Machine-Shop Engineering and/or H.N.C. required.

Salaries in accordance with Burnham Technical Scales:

Lecturer, £965-£1065.
Grade B, £525-£820, with additions for training, experience, etc.

Further particulars and forms of application from the undersigned (s.a.e.).

G. W. R. LINES,
CLERK TO THE JOINT EDUCATION COMMITTEE.

EDUCATION OFFICES,
NORTH STREET,
WOLVERHAMPTON. K 234

LONDON COUNTY COUNCIL.

Vacancies in the Structural Engineering Division for **RESIDENT ENGINEERS** (salary up to £945). Candidates should have B.Sc., A.M.I.C.E., or A.M.I.Struct.E., preferably with experience in supervision of reinforced concrete and/or steel-framed structures on the site, although those with adequate knowledge and experience of design alone will also be considered. Application forms, returnable by 20th March, from ARCHITECT, (AR/EK/RE/2), THE COUNTY HALL, S.E.1. (108). K 217

NATIONAL COAL BOARD.—Applications are invited for the post of **ASSISTANT CIVIL ENGINEER** in the Headquarters of the Scottish Division. The salary will be within range £800 to £1300. Applicants must have had civil engineering training and preference will be given to those with experience of railway layout and railway operation. Applications stating full details of age, education, qualifications, experience (in chronological order), present post and salary to STAFF DEPARTMENT, 3, EGLINTON CRESCENT, EDINBURGH, 12. K 205

TECHNICIANS

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE.

POST A (REF. 1006/26).

To act as a member of a shift pool supervising industrial staff engaged in operation and maintenance of electrical and mechanical plant and equipment. Duties will include the routine inspection of essential items of equipment involving, in some cases, the wearing of protective clothing, and maintaining technical records. The plant includes electric power and lighting equipment, air extrusion plant, hot water heating system, domestic services, automatic controls and alarms. Applicants should have served a recognised engineering apprenticeship. They should have a working knowledge of at least some of the equipment involved. Experience on engineering shift work in charge of ventilation plant and domestic services would be advantageous. Possession of O.N.C. or equivalent qualification is desirable.

POST B (REF. 1008/26).

To be responsible to a foreman for modifications to, and maintenance on special-purpose plants. The work includes heating and ventilating equipment, pipework for services and general erection work on Chemical Engineering plants and other installations. Candidates must be prepared to work shifts if necessary. Applicants should have served a recognised engineering apprenticeship, and be experienced in working on Chemical Engineering and other plants, service installations, maintenance and heating and ventilating equipment. Possession of O.N.C. an advantage.

SALARY: £608-£748 per annum.

Contributory Superannuation Scheme. Successful married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates, alternatively assistance towards legal expenses incurred in purchase may be available; until housed a lodging allowance may be payable.

Requests for application forms by POSTCARD to SENIOR RECRUITMENT OFFICER AT THE ABOVE ADDRESS, quoting the appropriate reference number. K 172

UNIVERSITY OF DURHAM.

KING'S COLLEGE, NEWCASTLE-UPON-TYNE.

Applications are invited for the post of **RESEARCH ASSISTANT IN THE DEPARTMENT OF CIVIL ENGINEERING** at a commencing salary of between £560 and £600 per annum, according to qualifications and experience. Candidates should be graduates in Civil Engineering.

The successful applicant will be engaged on a programme of research into prestressed precast concrete.

Applications, together with the names of three referees, should be addressed to the undersigned so as to reach him not later than 18th February, 1956.

G. B. HANSON,
REGISTRAR OF KING'S COLLEGE. K 246

ENGINEER required by MINISTRY OF SUPPLY, Fighting Vehicles Research and Development Establishment, near Chertsey, Surrey, on Laboratory and Field investigations into shock and vibration characteristics of electrical and electro-mechanical equipment fitted to Fighting Vehicles. Qualifications: 1st or 2nd Class Honours Degree or equivalent qualification in Mechanical or Electrical Engineering. Knowledge of modern instrumentation practice desirable. Salary within SCIENTIFIC OFFICER, range £488 10s.-£885 (Superannuable).—Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON S.W.1, quoting C.27/6A/BG. K 157

UNITED MANCHESTER HOSPITALS, MANCHESTER, 13.

GROUP ENGINEER.

Applications are invited from suitably qualified persons for the post of **GROUP ENGINEER** to the United Manchester Hospitals. Terms and Conditions of Service and the necessary qualifications are in accordance with Whitley Council Circular P.T.B. 38. Salary £875 by £25 to £975. The Teaching Hospital Group consists of five main hospitals with three additional branch hospitals and is on the points basis of 40|—50. The successful candidate will be required to take up his duties as soon as possible after 1st April, 1956 (residential accommodation may be available).

Applications, giving full qualifications and details of experience, together with the names of three persons to whom reference may be made, should be sent to the undersigned not later than 15th February, 1956. Envelopes should be marked "Group Engineer."

F. J. CABLE,
SECRETARY TO THE BOARD OF GOVERNORS. K 145

NORTH THAMES GAS BOARD.

SENIOR DRAUGHTSMEN are required in the **CHIEF ENGINEER'S DRAWING OFFICE AT WESTMINSTER, S.W.1,** for:—

(a) the design and detailing of Civil Engineering, Foundations and Structural Work mainly in reinforced concrete associated with Gas Manufacturing Plant;
(b) the design and layout of general process plant and all associated structural steelwork.

Candidates should preferably be Corporate Members of the Institutions of Civil, Structural or Mechanical Engineers. Starting salaries within the range £790 to £940 per annum, according to age, qualifications and experience. The successful candidates will be required to join the staff pension scheme.

Applications, giving age and full particulars, should be sent to the STAFF CONTROLLER, NORTH THAMES GAS BOARD, 30, KENSINGTON CHURCH STREET, LONDON, W.8, quoting reference 666/314. K 151

NATIONAL COUNCIL FOR TECHNOLOGICAL AWARDS.

Applications are invited for the post of **SECRETARY TO THE COUNCIL,** which has been set up by the Minister of Education as an independent body under the Chairmanship of Lord Hives for the purpose of conferring awards in technology on students of technical colleges.

Applicants should be graduates, preferably between the ages of 35 and 45, with a general knowledge of the content, organisation and administration of technical education in this country. Experience in industry will be an advantage.

Salary will be in the range of £1500 to £2000 and the initial salary will be determined in the light of the qualifications and experience of the successful candidate. Arrangements for superannuation will be made.

Applications should be accompanied by the names and addresses of three referees and must be sent not later than 22nd February, 1956, to:

F. G. WARD,
ACTING SECRETARY,
NATIONAL COUNCIL FOR TECHNOLOGICAL AWARDS,
MINISTRY OF EDUCATION,
CURZON STREET,
LONDON, W.1. K 234

CITY OF NOTTINGHAM.
WATER DEPARTMENT.

CIVIL ENGINEERING ASSISTANT.

Application for this permanent, pensionable appointment are invited from Engineering Graduates, and should be sent to the Engineer and General Manager, Water Department, Castle Boulevard, Nottingham, by the 10th February next, with the names of two persons to whom reference may be made. Salary in accordance with Grade A.P.T.II of the National Scale, viz., £595 by £20 to £675, or, in the case of graduates who have had at least five years' satisfactory experience, £690 by £30 to £840.

T. J. OWEN,
TOWN CLERK.
GUILDHALL,
NOTTINGHAM. K 160

EXPERIMENTAL OFFICERS AND ASSISTANT EXPERIMENTAL OFFICERS in various Government Departments. The Civil Service Commissioners invite applications for pensionable posts. Applications may be accepted up to 31st December, 1956, but forms should be returned as soon as possible as an earlier closing date may be announced either for the competition as a whole or in one or more subjects.

The posts are divided between following main groups and subjects (*a*) Mathematical and Physical Sciences, (*b*) Chemistry and Metallurgy, (*c*) Biological Sciences, (*d*) Engineering subjects and (*e*) Miscellaneous (including, *e.g.*, Geology, Library and Technical Information Services.)

AGE LIMITS: For Experimental Officers, at least 26 and under 31 on 31st December, 1956; for Assistant Experimental Officers at least 18 and under 28 on 31st December, 1956. Extension for regular service in H.M. Forces. Candidates aged 31 or over with specialised experience for Experimental Officer posts may be admitted.

Candidates must have at least one of a number of specified qualifications. Examples are Higher School Certificate, General Certificate of Education, Scottish Leaving Certificate, Scottish Universities Preliminary Examination, Northern Ireland Senior Certificate (all in appropriate subjects and at appropriate levels). Higher National Certificate, University degree. Candidates taking their examinations in 1956 may be admitted. Candidates without such qualifications may be admitted exceptionally on evidence of suitable experience. In general a higher standard of qualification will be looked for in the older candidates than in the younger ones.

Salary (London):—
Experimental Officer—£790 to £960 (men); £706 to £866 (women).
Assistant Experimental Officer—£320 (at age 18) to £790 (men), £628 (women). Starting pay up to £575 (men) or £541 (women) at 26 or over. Somewhat lower outside London. Promotion prospects. Women's scales being improved under equal pay scheme.

Further particulars from CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, 30, OLD BURLINGTON STREET, LONDON, W.1. quoting No. S94-95/56. K 155

HER MAJESTY'S OVERSEA CIVIL SERVICE.

MECHANICAL ENGINEER.

LAND SETTLEMENT DEPARTMENT, BRITISH GUIANA (BCD/131/30/02).

Duties are to take charge of the Department's engineering workshop and of the operation of its machinery pool entailing responsibility for the selection, maintenance and field operations of mechanical equipment including tractors, ploughs, draglines and earth-moving and land-clearing machinery; also for the training of operators for mechanical equipment.

Appointment is either pensionable on probation for three years or on contract gratuity terms for three years in the first instance in the salary range £770 to £1400 per annum. A gratuity of 22½ per cent. of basic salary in the case of a contract appointment, calculated for every three months satisfactory service is payable either at six-monthly intervals or on completion of the contract. Leave at the rate of 5 days for each month of resident service up to maximum of six months.

Free passages for the officer, his wife and up to three dependent children up to age of eighteen.

Candidates should be A.M.I.Mech.E., or have passed or be exempt from Sections A and B of the examinations of the Institution of Mechanical Engineers. They should have practical experience of mechanical tillage with earth-moving and land-clearing machinery.

Apply in writing to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD/131/30/02. K 162

GOLD COAST LOCAL CIVIL SERVICE.

INSPECTOR OF MACHINERY,
MINES DEPARTMENT.

A vacancy for an **INSPECTOR OF MACHINERY** exists in the Mines Department, Local Civil Service, Gold Coast. Duties include inspection of Electrical and Mechanical appliances of Mines, particularly winding equipment, boilers and other pressure vessels; enforcement of Mining Regulations and supervision of a Mechanical laboratory.

Appointment on contract for 2 tours of 18 to 24 months each in salary range £1130-£2020 per annum point of entry depending on experience. Gratuity of £12 10s. payable for each completed month of satisfactory service. Outfit allowance of £30-£60 also payable.

Free passages provided for officer, wife, and up to 3 children under 13 years of age. Government quarters, if available, provided at rental of £60-£90 per annum. Leave at rate of 7 days for each completed month of residential service after a tour of 18-24 months.

Candidates must be A.M.I.Mech.E. or A.M.I.E.E. with experience in a responsible position in preferably both Electrical and Mechanical Engineering as applied to Mining. Knowledge of testing engineering material also required. Minimum age 30.

Apply in writing to DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, S.W.1, giving briefly age, qualifications and experience and quoting reference No. BCD 99/103/04. K 232

LONDON TRANSPORT require **DRAUGHTSMAN** for Acton Works.

Qualifications: preferably with experience in design of machine tools, material handling equipment, factory layout and services; apprenticeship and ordinary or higher national certificates advantageous. Salary range £320-£660, with additional payments for certain recognised qualifications. Medical exam.; contributory superannuation scheme after probation; free travel.—Applications to RECRUITMENT AND TRAINING OFFICER (F/EV 565), LONDON TRANSPORT, 55, BROADWAY, S.W.1. For acknowledgement enclose addressed envelope. K 231

NORTH THAMES GAS BOARD.

A SENIOR DRAUGHTSMAN, AGED 30-45, is required at the Chemical Products Works, Beckton, E.6. Candidates should have considerable experience in the design and layout of plant from flow diagrams, and in the preparation of schemes and contract specifications both for development and maintenance work. Starting salary will be within the range £700 to £850 per annum according to age, qualifications and experience. The successful candidate will be required to join the Staff Pension Scheme.

Applications giving age and full particulars to STAFF CONTROLLER, NORTH THAMES GAS BOARD, 30, KENSINGTON CHURCH STREET, W.8, quoting reference 666/324. K 228

CAMBRIDGESHIRE EDUCATION COMMITTEE.

CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART.

Applications are invited for the post of **LECTURER IN PRODUCTION ENGINEERING** to take classes up to Final C.G.L.I. in Machine Shop Engineering and to be responsible for the future development of the Engineering Workshop.

Candidates should have appropriate qualifications, a sound machine shop training and good industrial and teaching experience. Experience in Instrument Making would be an additional recommendation.

The successful applicant will be required to take up his duties on 16th April, or as soon thereafter as possible. Salary will be in accordance with the current Burnham Award for Teachers in Establishments of Further Education, i.e. £965 by £25 to £1065.

Further particulars of the appointment and a form of application may be obtained from the PRINCIPAL, CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, COLLIER ROAD, CAMBRIDGE. K 220

MINISTRY OF SUPPLY requires **ENGINEER** at Woolwich to help direct the inspection of guided weapon warheads, their filling and assembly, also packaging for all Air stores. QUALIFICATIONS: British of British parents. Recognised engineering apprenticeship and A.M.I.Mech.E. or E.E. or exempting qualifications, or A.F.R.Ae.S. Knowledge explosives essential, and experience of production or inspection of such stores as shells or bombs desirable. SALARY: Within £705 (age 25)-£1095 p.a. Application forms from M.L.N.S., TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, S.W.1. Quoting C806/5A/BG. Closing date, 17th February, 1956. K 179

WEST AFRICAN INSTITUTE.

FOR OIL PALM RESEARCH, NIGERIA.

Applications are invited for the post of **RESEARCH ENGINEER,** at the WEST AFRICAN INSTITUTE FOR OIL PALM RESEARCH.

Duties are primarily research and development in connection with engineering problems, particularly those arising in the processing of oil palm fruit in plantation oil mills of various kinds. The officer will be required to work in close collaboration with other members of the Institute staff concerned with the production of the crop in the field and will be required to modify existing plant or design new.

Appointment is either pensionable or on contract in the gross salary range £1292 10s. to £2437 10s. p.a. with a gratuity of £122 to £275 10s. p.a. in the case of a contract appointment.

Free passages are provided for the officer, his wife and all children under 13 years of age. Furnished Government quarters are provided if available at a rental of 10 per cent. basic salary subject to a maximum of £150 per annum. Leave is granted at the rate of three days for each completed month of resident service.

Candidates, not less than 26 years of age, should hold a good honours degree in Mechanical or Chemical Engineering, and have had at least 3 years' post-graduate experience in the design and operation of plant for vegetable oil extraction and processing. They must possess a "research outlook" and should be well versed in the critical appreciation of practical problems from a scientific angle. They must be well qualified engineers with a particular aptitude for mechanical matters, and have a good knowledge and experience of chemistry.

Apply, in writing, to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD.197/199/01. K 163

GOVERNMENT OF EASTERN NIGERIA.

EXECUTIVE ENGINEER (MECHANICAL)
PUBLIC WORKS DEPARTMENT.

Duties include the supervision of the management of a large workshop and a number of small workshops within area of responsibility, including supervision and control of the maintenance and repair of Mechanical Engineering plant and vehicles required for the construction and maintenance of all types of Civil Engineering Works, also Water Works plant.

Appointment is on contract in the salary range £1290-£1956 per annum gross, point of entry dependent on qualifications and experience. A gratuity of £37 10s. for each completed 3 months' service is payable on satisfactory completion of contract. Government quarters are provided if available at a rental of 10 per cent. of salary. Free passages are provided for the Officer, his wife, and the cost of passages for two children under 18 up to a maximum of £75 each, or an allowance for their maintenance in the United Kingdom. Leave is granted at the rate of seven days for each month of resident service in a tour of 18-24 months.

Candidates between 25 and 50 years of age should hold a University Degree in Mechanical Engineering or should have passed or be exempt from Sections A and B of the examinations for A.M.I.Mech.E., or A.M.I.C.E. (in Mechanical subjects) and have at least three years' practical experience of mechanical engineering work, experience of diesel and petrol engines, drawing office and machine shop practice, workshops and stores procedure.

Apply in writing to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD112/411/05. K 165

FEDERAL PUBLIC WORKS DEPARTMENT—NIGERIA.

SENIOR EXECUTIVE ENGINEERS (ROADS)

Duties:—Control of a road construction organisation in the bush including construction of bridges, culverts, drainage works and the laying of bituminous surfacing.

Appointment on Contract/Gratuity terms. Gross salary, £2448 p.a., plus gratuity, payable on satisfactory completion of contract, at rate of £37 10s. for each period of 3 months' service (including approved leave). Free passages provided for Officer, wife and assistance for children. Generous home leave.

Candidates should be Corporate Members of the Institution of Civil Engineers or hold a University degree recognised as exempting from the Final Parts I and II of the A.M.I.C.E. examination or equivalent qualification. They should have at least 15 years' practical experience of road and bridge construction and preferably some experience in a tropical country.

Further particulars on written application to the DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, SANCTUARY BUILDINGS, GREAT SMITH STREET, LONDON, S.W.1. Please give brief details of age, qualifications and experience and quote reference BCD/112/14/032/D5. K 164

CENTRAL ELECTRICITY AUTHORITY.
LONDON DIVISION.

Applications are invited for the following superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. an advantage.

ASSISTANT ENGINEER (EFFICIENCY).
BATTERSEA POWER STATION.
Vacancy No. 56/56

Engineer appointed will carry out investigations on all matters concerning Thermal Efficiency and carry out necessary tests on Boilers, Turbines, etc. He will also generally supervise preparation of station statistics. Salary—Class I., Grade II = £829 10s. p.a.

Applications, quoting vacancy number, may be made on the form obtainable from DIVISIONAL SECRETARY, CENTRAL ELECTRICITY AUTHORITY, LONDON DIVISION, P.O. BOX 136, GENERATION HOUSE, GREAT PORTLAND STREET, W.1, to be received within 14 days of this advertisement. K 171

The Industrial Group of THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY has vacancies at Risley for

SENIOR ENGINEERS in its Design Offices, which are engaged on an expanding programme of industrial applications of nuclear energy. Very large projects are involved, such as nuclear power reactors and their associated chemical and physical process plants. A design office has an overall responsibility normally for one such project at a time. Designs are made in close collaboration with development and research groups and assistance is given by specialised engineering and commercial branches. The design office maintains close contact with manufacture and site construction. A Chief Engineer is responsible for a design office, and has a Deputy Chief Engineer and several Assistant Chief Engineers carrying responsibility for the whole range of duties covering specific parts of the project. While much of the work is novel, previous experience of nuclear engineering is not essential and a sound training in mechanical or chemical engineering with considerable experience of high quality design work in one of these fields, and good technical judgement will enable an engineer quickly to take an effective part in the work.

The Authority would be interested to hear from Engineers with the special qualifications and wide experience of large engineering projects enabling them to undertake the duties of Chief Engineer as described above. Salaries would reflect the very substantial responsibilities of these posts. There are also a number of vacancies as Deputy Chief Engineer and Assistant Chief Engineer, affording opportunities in this new and essential industry. Salaries are in the ranges £2200-£2700 and £1700-£2200 respectively.

Applicants in all cases should be corporate members of a Senior Engineering Institution, or possess an honours degree in mechanical or chemical engineering and have served an engineering apprenticeship or pupilage.

Those qualified and interested should write to: W. L. OWEN, C.B.E., M.Eng., M.I.C.E., M.I.Mech.E. M.I.Chem.E., DIRECTOR OF ENGINEERING, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, RISLEY, LANCASHIRE. K 192

TECHNICIAN required by the ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS., to assist in the control of a section responsible for:—

(*a*) The provision, installation, modification and maintenance of machine tools, equipment and fixtures;
(*b*) the investigation of machining techniques in collaboration with scientists and design engineers;
(*c*) development of special fixtures and modifications to machine tools;
(*d*) liaison with contracts branches and machine tool manufacturers.

Applicants should have served a recognised engineering apprenticeship. A good knowledge of machine tools in general use and current workshops practice is essential. Previous experience of duties of the type detailed above and possession of H.N.C. or equivalent qualification an advantage.

Salary: £873-£1080 p.a. Contributory Superannuation scheme. Married officers now living outside the Establishment's transport area will be eligible for for housing on one of the Authority's estates, alternatively assistance towards legal expenses incurred in house purchase may be available; until housed a lodging allowance may be payable.

Requests for application forms by POSTCARD to the SENIOR RECRUITMENT OFFICER at the above address. Quote reference 801/26. K 194

Classified Advertisements continued on Page 4

PRESTON.

HARRIS INSTITUTE TECHNICAL COLLEGE.

Applications are invited for the post of **ASSISTANT LECTURER, GRADE B,** in the Mechanical Engineering Department.

Candidates should possess a Degree or equivalent qualification and should have had good practical experience.

Ability to teach such subjects as Workshop Technology, Machine Tools, Metrology and Jig and Tool Design to Higher National Certificate level is desirable.

Forms of application may be obtained from the undersigned, TECHNICAL COLLEGE, CORPORATION STREET, PRESTON, to whom they should be returned within 14 days from the appearance of this advertisement.

H. WILKINSON,
Principal and Secretary. K 201

ADEN COLONY HOSPITAL, ADEN.

Applications are invited for appointment of **MECHANICAL AND ELECTRICAL INSPECTOR** to serve in Aden to supervise erection of Mechanical, Electrical and Air Conditioning Plant. Duration of contract and testing about 2 years. Candidates should preferably have engineering qualifications and experience of similar work abroad. Salary £1600 p.a.—Applications to OSCAR FABER & PARTNERS, CONSULTING ENGINEERS, 29, QUEEN ANNE STREET, LONDON, W.1, stating age, qualifications, experience, naming three referees. K 204

APPOINTMENTS OPEN.

THE ENGAGEMENT OF PERSONS answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

It is advisable when sending testimonials to forward copies and NOT originals.

JUNIOR DRAUGHTSMEN, having completed National Service, required for work on large chemical plant installations. A.E.S.D. minimum rates or above. Five-day week and superannuation scheme.—Apply by letter giving details of technical education to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 575

BRITISH PETROLEUM COMPANY LIMITED offers
STUDENT APPRENTICESHIPS IN MECHANICAL AND CHEMICAL ENGINEERING for men who have completed their period of National Service and who possess G.C.E. in five subjects of which Mathematics and/or Physics must have been passed at "A" level and English at "O" level. Age 19-22. The apprentices will attend a Technical College for a full-time Sandwich Course of Studies during their first six months and will then go to a Refinery for practical training. The Course is of 4 years duration.—Applications giving full details of education and experience should be addressed to MANAGER, RECRUITMENT BRANCH, quoting reference H.3570, to BOX 8347, c/o 191, GRESHAM HOUSE, E.C.2. G 608

MECHANICAL AND ELECTRICAL SERVICES ENGINEER required by Consulting Engineers in Birmingham. Permanent post with pension scheme.—Reply in confidence giving qualifications, previous experience, age, etc., to BOX No. 300, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 596

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential, applicants with general mechanical engineering experience will be favourably considered. The posts offer excellent opportunities with generous salaries commensurate with experience and ability. Offices situated in the N.W.1 London area. Five-day week and superannuation scheme.—Applications, which will be treated in confidence, should give previous experience and qualifications and be addressed to the CHIEF DRAUGHTSMAN, LAPORTE CHEMICALS LIMITED, CLIFTON HOUSE, EUSTON ROAD, LONDON, N.W.1. G 576

BRITISH PETROLEUM COMPANY LIMITED has a vacancy for a
STATISTICIAN in the Physics Section at its Research Station at Sunbury-on-Thames. Applications are invited from men who have completed a degree course in Statistics or who have had equivalent experience. Work will be on statistical problems in the oil industry including statistical design of experimental programmes. Applicants should be capable of co-operating fully with Research Staff and of ensuring that statistical techniques are used to the best advantage. Knowledge of the oil industry is not an essential. Excellent working conditions. Non-contributory Pension Scheme and Luncheon Club facilities. Write giving full details, quoting H.3308, to BOX 8207 c/o 191, GRESHAM HOUSE, E.C.2. G 597

RESEARCH ENGINEER OR PHYSICIST

with advanced knowledge of thermodynamics required by a Glasgow Engineering Company. Applicants, aged 25-30, should have a University Honours Degree. Experience in heat transfer problems would be an advantage. Salary depending on qualifications and experience.—Apply to BOX G 583, Offices of ENGINEERING.

DESIGNER-DRAUGHTSMEN
and
DETAIL DRAUGHTSMEN
With Crane or Structural Experience required by
COWANS, SHELDON & CO., LIMITED,
of Carlisle.
Good Commencing Salary and Pension Scheme. G 622

Rocket Division of Armstrong Siddeley Motors has really good vacancies for
DESIGNERS AND DRAUGHTSMEN intent on furthering their career in this new branch of propulsion. Applicants must have had minimum of three years drawing office experience and preferably hold at least a Higher National Certificate in Mechanical Engineering. Drawing office experience, however, is preferable to academic qualifications. Due to new projects and consequent expansion of departments prospects for men of the right calibre are unusually good. This is a fine opportunity to enter on the ground floor of new and fascinating work with far reaching implications. Initial salary range £13 10s. to £16 10s. per week.—Apply for a personal interview with our Chief Designer, Rocket Division by writing to TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY, quoting reference RD/DD. G 631

CANADA

LAMINATED STRUCTURES LIMITED

Canada's leading designers and fabricators of glued laminated and sawn timber structures, have

THREE PERMANENT OPENINGS
For
DESIGN ENGINEERS
AT THEIR HEAD OFFICE IN MONTREAL

Applicants must hold a recognised degree and possess at least two years' general structural design experience. Knowledge of timber construction would be an advantage but is not essential.

Starting salary ranges from $3,600 to $4,800 (£1,300—£1,750) per annum depending on experience. Group insurance and pension plan available. Boat fare to Montreal paid under contract basis. Apply in writing immediately, giving personal details and full particulars of past experience to:—

T. A. ELDRIDGE, c/o W. H. WILLATTS & ASSOCIATES, 28 ST. GEORGE STREET, HANOVER SQUARE, LONDON, W.1

Personal interviews will be conducted in London, 13th—18th February, 1956.

K 119

ELECTRICAL DRAUGHTSMAN, AGE 30-35, of at least National Certificate in Electrical Engineering standard. Permanent position with pension scheme. Applicant should be capable of working with minimum supervision, and be conversant with equipment layout, schematic and main connection diagrams, and ordering of electrical equipment. Estimating experience would be an advantage. Applications to COWANS, SHELDON & CO., LTD., CRANE MANUFACTURERS, CARLISLE, with particulars of experience and salary required. K 79

SENIOR DRAUGHTSMAN required for important and interesting work in the Steam Turbine Drawing Office, BRUSH ELECTRICAL ENGINEERING CO. LTD., LOUGHBOROUGH. Applicants must have previous experience of this class of work. There is considerable scope for an energetic man capable of working with the minimum of guidance. Conditions of service include good salary and generous non-contributory superannuation scheme.—Please reply to the CHIEF PERSONNEL OFFICER. K 122

BRITISH PETROLEUM COMPANY LIMITED has a vacancy in the MIDDLE EAST for an **ENGINEER ESTIMATOR.** Applicants, under 35 years of age, must have served a full five-year Engineering Apprenticeship including Drawing Office work and should possess Higher National Certificate or Associate Membership of Institute of Mechanical Engineers. Three years' Estimating experience on general Mechanical and Civil Works is essential and preference will be given to candidates with experience on Construction Works within the Oil Industry. Attractive salary plus generous allowance in local currency, air-conditioned accommodation, free passages, kit allowance, free medical attention, good leave arrangements. Pension Scheme.—Write, giving full particulars of qualifications and experience, quoting F.513, to BOX 1697, c/o 191, GRESHAM HOUSE, E.C.2. K 150

APPLICATIONS ENGINEER with experience in the Marine field, required to design and develop control schemes for ships auxiliary drives for A.C. and D.C. ship propulsion. Candidates must have a knowledge of generator and motor design for marine applications. This post offers excellent scope for advancement in a vigorous and expanding company. Conditions of service include generous non-contributory superannuation scheme and an attractive salary will be paid.—Please reply to the CHIEF PERSONNEL OFFICER, BRUSH ELECTRICAL ENGINEERING COMPANY, LTD., LOUGHBOROUGH, LEICS. K 123

Leading manufacturers of container closures in the Midlands have a number of vacancies for ambitious **DESIGN DRAUGHTSMEN** preferably with some experience in this or a similar sphere. Interesting work with excellent salary and every opportunity for promotion to senior position in a rapidly growing organisation. Write in confidence with details of experience, positions held, salary required: to P. A. METAL CLOSURES LIMITED, BROMFORD LANE, WEST BROMWICH. G 627

THE AERODYNAMICS DEPARTMENT OF ARMSTRONG SIDDELEY MOTORS has vacancies for both
SENIOR AND JUNIOR DEVELOPMENT ENGINEERS for work on axial flow compressors, turbines and general airflow. A Degree in Mechanical Engineering and previous experience in this type of work an advantage. Initial salaries range from £650 to £1050 per annum, dependent on age, experience and qualifications but superscale rates would apply to senior experienced men. Excellent prospects and good pension fund.—Applicants should give full details quoting Reference Airflow 2, to TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 625

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD

ARMAMENTS DIVISION

1. DEPUTY TO CHIEF DYNAMICS ENGINEER

A vacancy exists for a Senior Engineer as a Deputy to the Chief Dynamics Engineer of a major organisation in the Guided Weapons Industry.

Applicants must have completed an apprenticeship with a well-known firm and should have a minimum of five years' experience on Research or Development work; preferably with some experience of vibration or climatic testing.

Qualifications should include an Honours degree in Electrical or Mechanical Engineering, and some experience in taking charge of technical personnel is essential.

The salary scale will be commensurate with the high degree of responsibility associated with this post.

2. TECHNICIANS

Two Technicians are required for Dynamic and Climatic investigations which cover a wide variety of problems.

The essential qualifications required are a degree in Electrical or Mechanical Engineering or its equivalent, and one to three years' practical experience in this type of work.

These posts offer an interesting career, together with attractive salaries and with good opportunities for advancement.

Excellent working conditions and amenities are provided, and an attractive superannuation scheme is in operation.

All replies should be addressed to :—

TECHNICAL APPOINTMENTS OFFICER,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.,
BAGINTON, NR. COVENTRY,
Quoting reference ARM/TAO.

K 135

Are you looking for interesting and varied work connected with Design, Development and Testing of a wide variety of new pieces of equipment for mechanical handling in Collieries and for Railway Signalling ? We have vacancies for young men with ideas to work on mechanical, pneumatic and/or Electro-mechanical projects.

You are not expected to have had experience of this particular type of work and training will be arranged where necessary for successful applicants. Some of the posts may well be filled by those with a few years' experience as a design draughtsman.

POSTS ARE AVAILABLE FOR GRADUATES OR FOR THOSE STILL STUDYING FOR THEIR NATIONAL CERTIFICATES IN MECHANICAL OR ELECTRICAL ENGINEERING and starting salaries will be in accordance with age, experience and qualifications. There is excellent scope for advancement for those with ability and initiative. Five-day week and pension scheme. For further information apply to PERSONNEL SUPERINTENDENT, WESTINGHOUSE BRAKE & SIGNAL CO. LTD., CHIPPENHAM, WILTS., quoting reference No. EQUIP/N/L/. J 878

DEPUTY CHIEF ENGINEER

THE CHAIRMAN of a large organisation engaged in LIGHT ENGINEERING covering diverse fields wishes to appoint a

DEPUTY CHIEF ENGINEER.

To a successful Deputy there will be prospects of early promotion to **CHIEF ENGINEER** and **DIRECTOR.** The **DEPUTY CHIEF ENGINEER** will be required to lead and co-ordinate a number of specialist engineering teams, each of outstanding ability in its own sphere.

Essential qualifications are an honours degree in engineering or physics, membership of one of the leading professional institutions and high standing in industry, academic work or Government service. If now engaged academically, or in Government service, it is essential that the applicant should have obtained good industrial experience at an earlier date.

The appointment is suitable only for a man with wide engineering interests and knowledge, creative capacity, judgment, and enthusiasm, and ability to organise, lead, work with, and inspire scientists and engineers. Marked technological ability in any narrow specialised field will not be of great advantage. Age range 40/45 years but applicants with extraordinary qualifications outside this age range will be considered.

Applications will be treated in the strictest confidence by the Chairman and no communication will be made to any other person without the applicant's permission.

Total emoluments will not be less than £5000 per annum.

Applications in writing, marking envelope "DCE," to 146, LEADENHALL STREET, LONDON, E.C.3. K 130

BRITISH PETROLEUM COMPANY LIMITED requires

ENGINEERS OR PHYSICISTS with University Degrees, for experimental work on internal combustion engines including gas turbine engines and motor vehicle engines of high performance. Previous practical experience is not essential, but applicants should have a keen interest in this type of work. Age preferably not above 33. Salaries within the range £650 to £1300 per annum, according to qualifications and experience.—Write, giving full details, quoting H.3299, to BOX 8565, c/o 191, GRESHAM HOUSE, E.C.2. G 638

Applications are invited from Mechanical Engineers for a vacancy as

DESIGN ENGINEER with a small but rapidly expanding company in Bath. The company manufactures special-purpose machinery, and experience in the maintenance and operation of process machinery would be an advantage. Minimum qualifications H.N.C. Age range, 28-40.—Applications, stating age, experience, qualifications and salary required, which will be treated in confidence, should be addressed to the PERSONNEL OFFICER, C.I.C. ENGINEERING LIMITED, STREET, SOMERSET. K 143

MECHANICAL ENGINEERING DRAUGHTSMEN required by JOHN SUMMERS & SONS, LIMITED, SHOTTON, CHESTER.—Applications in writing to STAFF DEPARTMENT at the above address. K 152

DRAUGHTSMEN. Applications are invited from experienced Mechanical Engineering and Design Draughtsmen to be the nucleus of a newly-formed Central Engineering and Planning Department to deal with expansion projects and new development work for the whole of the Pilkington Group of Companies at home and overseas.

Minimum starting salaries for Draughtsmen of H.N.C. standard range between £678 at age 25, to £800 at age 35, plus agreement and staff bonuses for which they become eligible after one year's service. Conditions include contributory Superannuation Fund, assisted house purchase and family education schemes.

Reply, stating age, qualifications and experience, to the GROUP CHIEF ENGINEER, PILKINGTON BROTHERS LIMITED, ST. HELENS, LANCASHIRE. K 159

SUPERVISOR.

A large machine tool company in the Midlands has a vacancy for a

SUPERVISOR of its apprentices, numbering approximately 500 boys.

The appointment requires a man of personality, good education, firmness and tact, with qualities of leadership well developed, and accustomed to dealing with young people. Some experience of engineering is desirable. Age group, 35-50. This is a permanent executive staff position and an adequate salary will be paid to the right individual.

Full details of previous appointments, experience and indicate salary required, to BOX K 178, Offices of ENGINEERING.

ELECTRONICS

F. E. Terman

Dean of the School of Engineering, Stanford University

ELECTRONIC AND RADIO ENGINEERING

The fourth edition of Terman's RADIO ENGINEERING, completely rewritten to include all the basic information essential to the electronic and radio engineer. New sections deal with microwaves, semi-conductors and transistors, and frequency modulation.

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Professor Seely has revised and expanded the material from his ELECTRON TUBE CIRCUITS and divided it into two companion volumes, elementary and advanced, which are independent of each other.

RADIO ELECTRONICS

An introductory textbook which discusses in considerable mathematical detail the essential processes and circuits important in the field of radio communications. The emphasis on physical and mathematical analysis will help the student to understand the fundamentals of communication.

460 pages approx. 53s 6d

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ELECTRONIC ENGINEERING

A physical and mathematical treatment of electron circuits important in all branches of electrical engineering except radio. It includes a general introduction to tubes and tube circuit principles, with a detailed analysis of the more important electron tube circuits.

575 pages 60s

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McGRAW-HILL PUBLISHING COMPANY LTD

ASSISTANT STRUCTURAL ENGINEER AND JUNIOR STRUCTURAL ENGINEER

required by

THE STEEL COMPANY OF WALES LIMITED (STEEL DIVISION), ABBEY WORKS, in their Civil Engineering Department.

The Assistant Structural Engineer will be required to organise and be responsible for the maintenance of steel buildings, crane gantries and general structures. His duties will also include the supervision of new steelwork for modifications and building extensions. An ability to organise and supervise labour is essential. Engineering qualifications would be an advantage.

Duties of Junior Structural Engineer will be to assist as above.

The positions are permanent and pensionable.

Those wishing to apply should write for official Application Form to :—

PERSONNEL SUPERINTENDENT,
THE STEEL COMPANY OF WALES LIMITED,
(STEEL DIVISION),
ABBEY WORKS,
PORT TALBOT, GLAM. K 227

PLANT INSPECTION SUPERVISOR required by International Group for service at oil refinery in MIDDLE EAST, age 30/40 years. Applicants must have Board of Trade Boiler Certificate, or equivalent, and possess good administrative ability; also, a minimum of eight years all-round inspection experience, with at least four years' experience in boiler inspection.

Two-year tour involved in first instance and substantial salary, payable also while on leave. Married accommodation and free family passages available. —Write, asking for application form and giving brief details of age, career, etc., to BOX EG. 607, c/o 191, GRESHAM HOUSE, E.C.2. K 144

DRAUGHTSMAN required for Engineering Department of modern Tar Distillery. Applicants should be of at least O.N.C. standard with General Engineering experience, preferably including plant layout and piping. Varied and interesting work, including some site work. Pension scheme, salary up to £750 per year.—Apply to CHIEF ENGINEER, LANCASHIRE TAR DISTILLERS LIMITED, LIVERPOOL ROAD, CADISHEAD, NR. MANCHESTER. K 149

Research and Development in Building and Civil Engineering.
Vacancy for

SENIOR ENGINEER with London firm of Contractors. Position of considerable responsibility. Candidates must have good qualifications and wide experience in the industry. Commencing salary not less than £2000 per annum. Pension Fund.—Write, giving details of age, any publications, experience in dealing with staff, and general qualifications, to BOX K 153, Offices of ENGINEERING.

DESIGN ENGINEERS. Young, well qualified engineers seeking a post giving scope for original thought and providing opportunities for service abroad are invited to write for further particulars to the PERSONNEL MANAGER, IMPERIAL SMELTING CORPORATION LTD., AVONMOUTH BRISTOL. Applicants must possess a university degree, preferably with honours and have had some post-graduate experience in chemical or heavy engineering. Practical experience, however, is considered less important than the ability to apply theoretical principles to the practical problems encountered in work of a pioneer nature. When writing please quote reference ISP/EG. K 181

DRAUGHTSMEN. Imperial Smelting Corporation Limited offers good opportunities to experienced Mechanical and Chemical Draughtsmen for design and detail work in connection with metallurgical and chemical plant and equipment. A wide variety of work is offered and good promotion prospects exist for young men holding or prepared to obtain H.N.C. or equivalent. All appointments are permanent and pensionable with excellent working conditions and amenities.—Write for application form to PERSONNEL MANAGER, IMPERIAL SMELTING CORPORATION LIMITED, AVONMOUTH, BRISTOL, giving brief details of age, qualifications and experience and quoting reference D/EG. K 182

SALES ENGINEER (TECHNICAL) required immediately by British affiliate of an American company to operate in Scotland: candidates should be capable of discussing technical problems in association with various processes met with in the fields of metal working, electronics and industrial lubrication; sound technical background up to B.Sc. standard, progressive outlook, proved sales ability and good appearance are essential requirements: the position offers scope for advancement within an organisation and provides interesting technical sales work.—Write, giving full personal details and industrial knowledge, also state salary required and whether owner of a car, to ACHESON COLLOIDS LIMITED, 18, PALL MALL, LONDON, S.W.1. K 230

CHLORIDE BATTERIES LIMITED.
Manufacturers of EXIDE Batteries.

An opportunity is available for a

GRADUATE WITH AN HONOURS DEGREE IN ELECTRICAL ENGINEERING to fill a vacancy on the technical side of the organisation. Candidates should not be more than 28 years of age and should have completed full-time National Service obligations. Applications will, however, be considered from suitable candidates at present in the Forces who are due for release within the next few months. Previous industrial experience, although desirable, is not essential.

The selected candidate will be given a period of training with specialist emphasis in all aspects of storage battery engineering and associated electrical equipment, and in all relevant matters relating to the manufacture, design, development and application of storage batteries. He will also be given an insight into the work of the commercial and selling departments so that he may gain a general prospective view of the company's organisation and activities, and a broad general insight into the problems of the battery industry.

For a person of the right calibre and potential, the post offers considerable opportunities for advancement to executive level within the organisation in this country, or with Associated Companies abroad. An attractive salary will be offered during the training period. A non-contributory pension scheme is in operation.

Applications should be addressed to the CHIEF PERSONNEL OFFICER, EXIDE WORKS, CLIFTON JUNCTION, SWINTON, MANCHESTER. K 224

ASSISTANT WORKS MANAGER.

A well-established and progressive Company manufacturing prefabricated concrete parts invites applications for the appointment of Assistant Works Manager with responsibility for Production Planning and Control, Work Study and yield. The prospects are very promising and a commencing salary up to £1000 per annum is offered. A Mechanical Engineer with a University Degree under 30 years of age is required, and all applications will receive careful consideration. Details of qualifications and experience should be sent to BOX K 222, Offices of ENGINEERING.

DRAUGHTSMEN required for LIGHTWEIGHT DIESEL TRAIN development work in the London area, also Technical and Sales Assistants for service, Sales and Production Liaison work. Applications in writing stating age, details of training, experience and salary required to: THE GENERAL MANAGER, BRITISH UNITED TRACTION, LTD., 14, HANOVER SQUARE, LONDON, W.1. K 219

A MECHANICAL ENGINEER with experience of method improvement, Work Study, Quality and Waste control is required by a well-known and progressive company to meet the needs of an expanding business. Conditions of service are attractive and prospects, which are outstanding, will give full scope for ambition and responsibility. Salary will be by arrangement, but a commencing salary up to £1500 per annum is envisaged. Applicants under 35 years of age, holding a University Degree will be considered, and should forward particulars of their qualifications and experience, in confidence, to BOX K 221, Offices of ENGINEERING.

CIVIL ENGINEERS

MERZ AND McLELLAN

CONSULTING ENGINEERS

Invite applications for the following vacancies in their Civil Engineering Design Office at Newcastle upon Tyne.

(1) **TWO SECTION LEADERS** with wide experience both in the design and construction of heavy industrial structures and general civil engineering works. Applicants should hold an engineering qualification.

(2) **DESIGNER/DETAILERS, SENIOR AND JUNIOR,** with previous experience in the design and detailing of either reinforced concrete structural steelwork or general civil engineering works. These vacancies offer good scope for gaining further experience in connection with Nuclear Energy and Steam Power Stations.

The above posts are permanent, a Pension Scheme is in operation and working conditions are good.—Applications quoting reference SAR should be addressed to MERZ AND McLELLAN, CARLIOL HOUSE, NEWCASTLE UPON TYNE, 1.

K 251

Classified Advertisements continued on Page 6

JIG & TOOL DRAUGHTSMEN
DESIGN DRAUGHTSMEN

JOSEPH LUCAS LIMITED, BURNLEY,

Manufacturers of Aircraft and Motor Equipment.

Require capable ambitious men to assist in the work of **GAS TURBINE DEVELOPMENT.** Here is an opportunity for men with initiative to obtain a progressive position. The work is extremely interesting and demands a high degree of skill and ingenuity. A generous pension scheme provides an assured future, the working conditions are excellent and full restaurant services are provided. High salaries are paid to the right men.

Apply to :

The Personnel Manager,
Hargher Clough Works, Burnley. J 868

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION.

METALLURGIST OR ENGINEER required as Head of the Coil Spring Federation Research Laboratory in Sheffield. Applicants should be capable of taking charge of laboratory research and development work concerned with springs, their manufacture, testing and use. They should also be familiar with materials both steel and non-ferrous alloys used in spring manufacture. Honours degree in Metallurgy or Engineering with experience of academic and applied research and authorship essential. Starting salary in the range £1200 to £1700 p.a. according to age, qualifications and experience. Post is superannuated under the F.S.S.U.—Written applications only quoting "C.S.F.1," to PERSONNEL OFFICER, B.I.S.R.A., 11, PARK LANE, LONDON, W.1. K 229

RUSTON-BUCYRUS LTD.
Excavator Specialists
invite applications from qualified engineers for appointment as

PRODUCTION MANAGER.

Basic requirements are University Degree in Engineering or Corporate Membership of one of the Professional Institutions plus practical knowledge of modern production systems, the latter is particularly important. This is an interesting and high level appointment in a modern and fully equipped works in the medium/heavy engineering industry.

Interested applicants should write in first instance giving age and all relevant particulars including approximate salary required, to :

PERSONNEL MANAGER,
RUSTON-BUCYRUS LTD.,
EXCAVATOR WORKS,
LINCOLN.
K 214

CHIEF ENGINEER required for group of British-owned mills in Europe. The duties will be essentially of a supervisory nature, but applicants must have practical experience of the operation and maintenance of steam-raising, power and electrical plant and should preferably hold a recognised qualification in mechanical and/or electrical engineering. A knowledge of the Textile or Paper Industries would be an advantage. Age 35-45. Good salary and conditions are offered.—Write in confidence, stating age, to BOX K 226, Offices of ENGINEERING.

UNILEVER LTD., require an **ENGINEERING DRAUGHTSMAN DESIGNER** for their London office. Workshop trained. At least O.N.C. standard. Required for the design and planned layout of special factory plant. Candidates should have experience in one or more of the following: (a) Steam Plant; (b) Material Handling; (c) Electrical Wiring; (d) Pipe Layouts. Pension Scheme and canteen. Send particulars of age, training and experience in full to: PERSONNEL DIVISION (WAD 108), UNILEVER LTD., UNILEVER HOUSE, LONDON, E.C.4. K 168

SITE ENGINEERS

required for heavy foundation construction contract in North East Coast area.

Apply with particulars to:—
DORMAN LONG (BRIDGE AND ENGINEERING) LTD.,
BRIDGE AND CONTRACTING DEPARTMENT,
38-40, BUTE STREET,
LUTON, BEDS.
K 195

A MAJOR OIL COMPANY has an opening in their West African Marketing organisation for an **OPERATIONS ASSISTANT** who should be a graduate in Civil or Mechanical Engineering not over 35 years of age and single. The duties would include preparation of engineering drawings, and specifications, estimates and bills of materials, and the supervision of the erection and installation of such items as building, pump stations, tankage, pipe runs, etc. The commencing salary would be £1080 per annum plus £132 p.a. location allowance. Each tour of duty is eighteen months with three months leave, the position being permanent.—Please apply with full particulars to BOX K 235, Offices of ENGINEERING, marking your letter and envelope WAF.

BRITISH PETROLEUM COMPANY LIMITED requires a

TECHNICAL ASSISTANT with an Honours Degree in Engineering, Chemical Engineering or Petroleum Chemistry and preferably with practical experience in automobile/diesel or combustion engineering fields. The appointment is of a planning nature connected with quality of petroleum fuels generally and a Degree is not absolutely essential provided other qualifications are acceptable. Non-contributory Pension Scheme. Luncheon Club.—Write, giving full details of qualifications and previous experience, quoting H.3606, to BOX 8521, c/o 191, GRESHAM HOUSE, E.C.2. K 169

BRITISH CELLOPHANE LIMITED, BRIDGWATER, SOMERSET, seeks

SENIOR AND JUNIOR DRAUGHTSMEN, for both **PERMANENT AND TEMPORARY** appointments, for work on machine design and chemical plant layout. Applicants should possess at least O.N.C. and have had three years' shop experience. Five-day week, Pensions Fund scheme for permanent appointments. Ref. No. E44.Eg.

THE TEMPORARY appointments are for a period of approximately two years' duration, subject to three months' notice and include generous subsistence allowances, and periodic home return rail fares.

ESTIMATOR (PERMANENT). Applicants should have served an engineering apprenticeship and have technical education up to O.N.C. standard. The work involved will be on the preparation of material and labour specifications in connection with engineering work, electrical estimating experience an advantage. Ref. No. E46.Eg.

ASSISTANT ENGINEER, AGE 23/30 (PERMANENT). Applicants should have an honours degree in mechanical engineering and have had some practical works experience. The duties will be on development, improvement and maintenance of chemical and other plant. Ref. No. E45.Eg.

ASSISTANT ENGINEER, AGE 25/30 (PERMANENT). Applicants should have a university degree and have works experience, or be an A.M.I.Mech.E. The duties will be on development, improvement and maintenance of plastic films extrusion plant and ancillary equipment. Ref. No. R43.Eg.

Write to the PERSONNEL OFFICER, stating full particulars and salary required, and quote Ref. Nos. as indicated. J 912

AN ENGINEER is wanted for an important post with SCHWEPPES. Applicants should be about 30 with engineering qualifications plus practical experience of plant layout planning installation, development and maintenance. A knowledge of electrical installations and modern bottling machinery techniques would be advantageous.—Write to the PERSONNEL MANAGER, 1/4, CONNAUGHT PLACE, LONDON, W.2, stating age, full experience and salary required. K 236

An interesting and progressive opportunity has occurred within a well-known Industrial Organisation for a

SENIOR MECHANICAL DRAUGHTSMAN for work in the North-West London area. The successful applicant will be engaged on problems of a general engineering nature. It is necessary for applicants to have some experience in the same field. A fully apprenticed person would be preferred.—Reply, stating full details of age, experience and qualifications, to BOX K 237, Offices of ENGINEERING.

DRAUGHTSMEN (EXPERIENCED) required for work in connection with installation of heavy new plant and involving bulk handling. Must have technical qualifications at least up to Higher National Certificate. Appointment confirmed after one year's satisfactory service. Bonus and pension schemes. Apply in writing giving age and full particulars of training and experience to the THAMES AREA ENGINEER, ASSOCIATED PORTLAND CEMENT MANUFACTURERS LTD., STONE CASTLE, GREENHITHE, KENT. K 184

AVELING-BARFORD, LTD., GRANTHAM

have vacancies in their expanding Drawing Office for

DESIGNERS AND DRAUGHTSMEN

to work on earthmoving equipment, excavators and contractors' plant. Some knowledge of this class of work is desirable but not essential. Experience on heavy automotive work would be an advantage. —Applications should be addressed to THE PERSONNEL MANAGER. K 223

YOUNG DRAUGHTSMEN / DESIGNERS, 21-25 YEARS of age, required to join expanding team on development work. Must have served works apprenticeship and be of at least O.N.C. standard. Work is most interesting comprising mechanical and electrical mechanisms allied to addressing and office machines.—Applications in writing, stating age, experience and salary required, to PERSONNEL MANAGER, ADREMA LTD., 2/10, TELFORD WAY, EAST ACTON, LONDON, W.3. K 166

CRANE SUBSIDIARY
of large firm
requires

MANAGER

experienced in
DESIGN AND MANUFACTURE
of
OVERHEAD AND JIB CRANES.

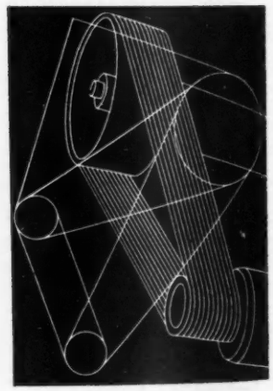
Reply stating experience and Salary, to BOX NO. 1861, c/o WHITE'S LTD., 72, FLEET STREET, E.C.4.
K 158

DESIGNER DRAUGHTSMAN required in London for the preparation of schemes and estimates for comprehensive materials handling installations. Must have had design experience in bulk handling equipment for Power Stations, Steelworks, Gas Works, etc., and only those having this experience will be considered. The position is a permanent one and the commencing salary will be of the order of £1000 per annum. A contributory pension scheme is in operation. Applicants should give the fullest details in first instance, and replies should be addressed to BOX K 186, Offices of ENGINEERING.

SMITH SHOP FOREMAN required for new railway wagon works being built by existing large Structural and Medium/heavy Mechanical Manufacturing Company in India. Must be experienced in rough forging and drop stamping of wagon components. 5 cwt. to 20 cwt. or larger hammers and 1 ton to 4 tons drop stamps being installed. Four years' agreement with renewal clause.—Write stating age and giving full particulars of training and experience to BOX Z.C. 571, DEACON'S ADVERTISING AGENCY, 36, LEADENHALL STREET, LONDON, E.C.3. K 241

Applications are invited for the position of **FOUNDRY MANAGER** of a modern fully-equipped foundry. Applicants must have held a similar position successfully and be familiar with modern techniques. Salary £900 p.a.—Apply TECHNALOY, LTD., AYLESBURY. K 225

"KNOW HOW"



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Head Office: STRAND HOUSE, LONDON, W.C.2

IMPERIAL CHEMICAL INDUSTRIES LIMITED
METALS DIVISION
invites applications from

DRAUGHTSMEN

to fill the following permanent positions

1. **SENIOR DESIGN DRAUGHTSMAN** with experience of heavy hydraulics, e.g., design and installation of extrusion presses, pumps, accumulators, pipework, valves, etc., operating at working pressures of up to 5000 p.s.i. H.N.C. qualifications preferred but sound practical knowledge essential.
2. **SENIOR DESIGN DRAUGHTSMAN** with good general knowledge of layout and design of mechanical plant, e.g., rolling mills and ancillaries, drawbenches, special purpose plant, materials handling equipment, etc. Work is widely varied and interesting. H.N.C. qualification preferred but sound design experience essential.
3. **SENIOR DESIGN DRAUGHTSMAN** with experience of the layout and design of heating and ventilation installations for industrial buildings including offices. A.M.I.H. & V.E. or equivalent qualification preferred.
4. **SENIOR DESIGN DRAUGHTSMAN** for interesting layout and design work connected with instrument installations applied to a wide range of plant producing non-ferrous metals. Experience to include working knowledge of electronics, electric and pneumatic control systems. H.N.C. qualification preferred.
5. **SENIOR DESIGN DRAUGHTSMAN ELECTRICAL,** experienced in layout of industrial power distribution, automatic control gear and substation work. Knowledge of lighting installations an advantage. Work is interesting, covering a wide range of plant and buildings connected with the production of non-ferrous metals. H.N.C. qualifications preferred.
6. **SENIOR DESIGN DRAUGHTSMAN** for general design work connected with gas and oil-fired furnaces and auxiliary equipment. H.N.C. qualification preferred.
7. **SENIOR DESIGN DRAUGHTSMAN** with good knowledge of pipework layout and detail for steam, water, gas and air services to buildings and plant. H.N.C. qualification preferred.
8. **JUNIOR DRAUGHTSMAN** for general mechanical design and detail work with special reference to safety requirements. Previous experience in this field not essential. The post offers excellent opportunities for gaining experience of a wide range of plant. H.N.C. qualification preferred.

These positions carry good commencing salary and there are excellent prospects for advancement for men with initiative and ability.

Financial assistance towards removal expenses are available for married men. Excellent conditions of employment include Staff Pension Fund, Employees' Profit Sharing Scheme, etc.—Application forms may be obtained from the STAFF MANAGER, I.C.I. METALS DIVISION, KYNOCH WORKS, WITTON, BIRMINGHAM, 6, quoting DR/3/O. K 174

HUMPHREYS & GLASGOW, LTD.

require

ESTIMATORS

Preferably with Drawing Office experience and a knowledge of Chemical or Gas Works Engineering. Permanent and Superannuated post carrying a good salary.

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K 215

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All applications with details of experience, qualifications and salary should be addressed to :—

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RUGBY. K 167

BRUSH ELECTRICAL ENGINEERING CO., LTD., LOUGHBOROUGH, LEICS, has a vacancy for a

DESIGN AND DEVELOPMENT ENGINEER in their Steam Turbine Department. Duties will involve Thermo-dynamic and Mechanical Design of turbine internals. Applicants should preferably hold an Engineering Degree but those with equivalent qualifications will be considered. Conditions include good salary and non-contributory staff assurance scheme.—Please reply in confidence to CHIEF PERSONNEL OFFICER. K 109

STRUCTURAL ENGINEER with wide experience of the design and detailing of all types of steel structures and with administrative experience required to act as deputy to the Chief Engineer by large firm of London Consultants. The firm is expanding and the vacancy offers excellent opportunities for the right type of man.—Write in confidence giving details of previous experience and salary required to BOX No. 355, GLOVERS ADVERTISING LTD., 351, OXFORD STREET, LONDON, W.1. G 635

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Apply Secretary, giving full details, age, experience and salary required. K 202

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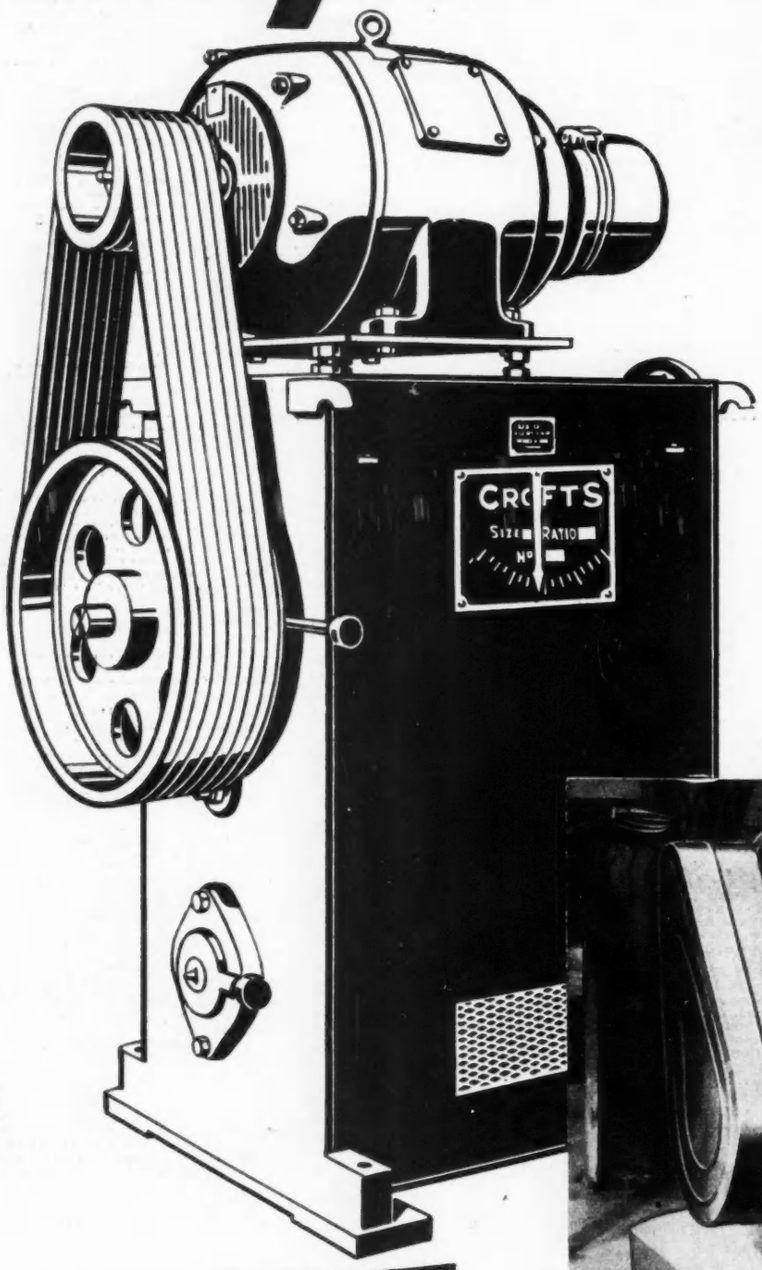

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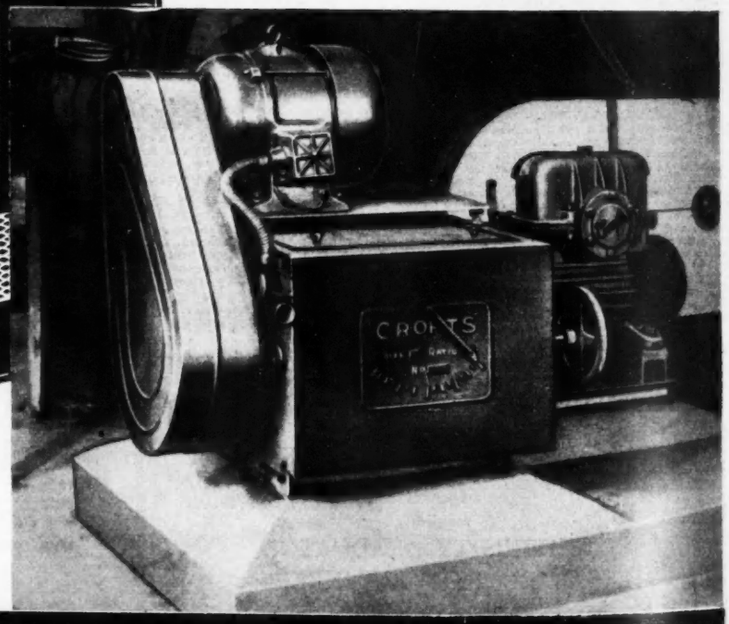

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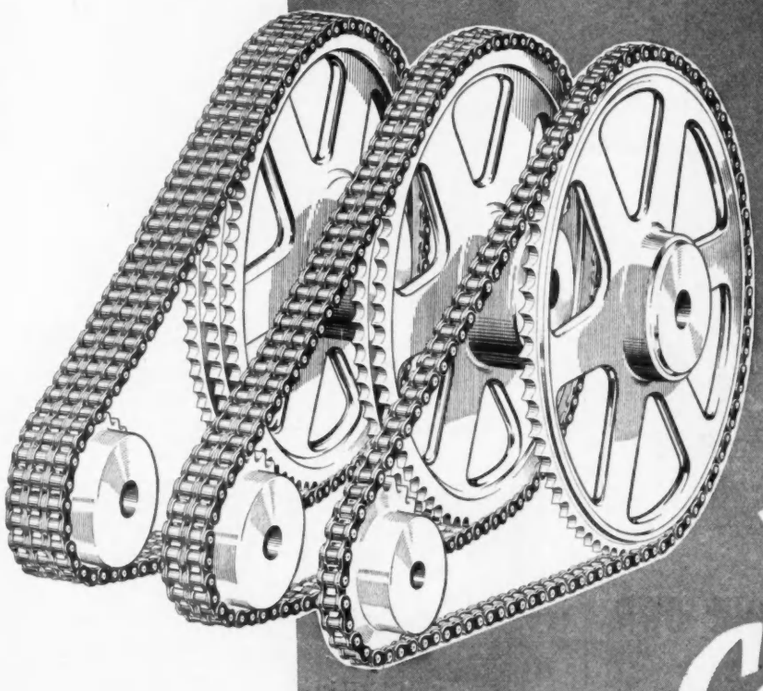

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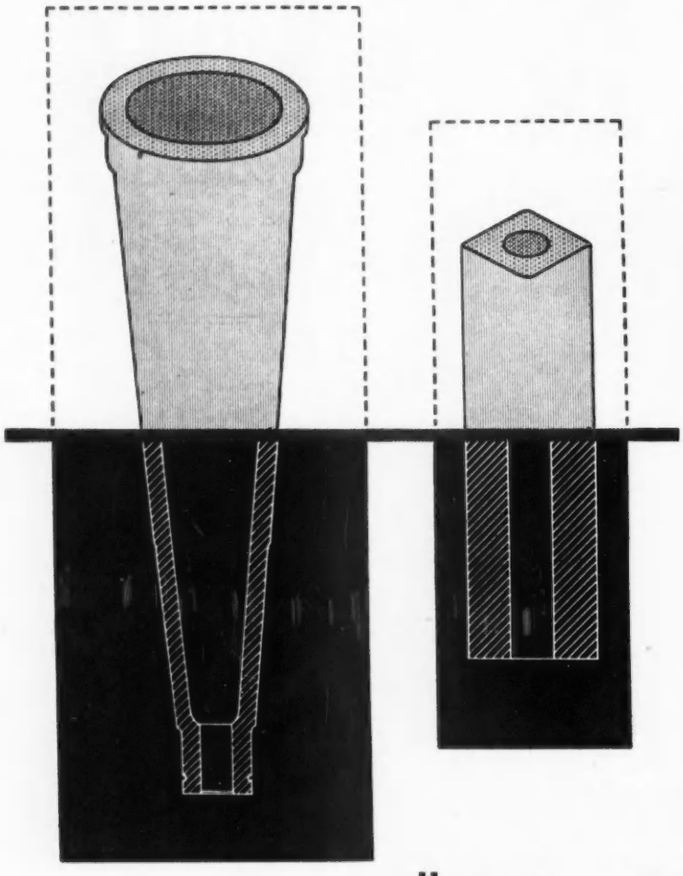

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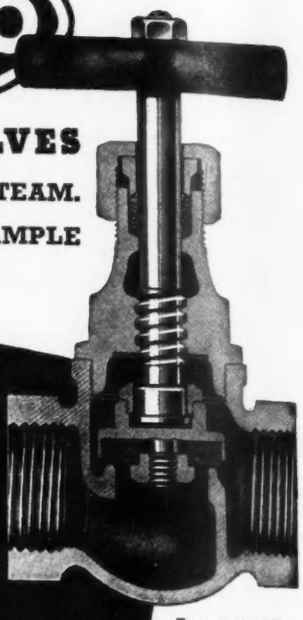

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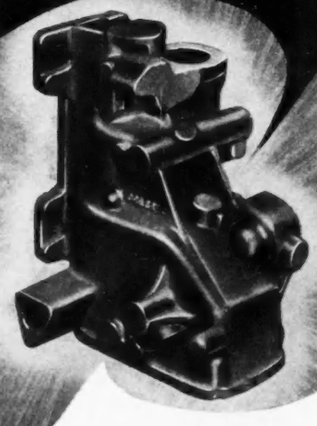

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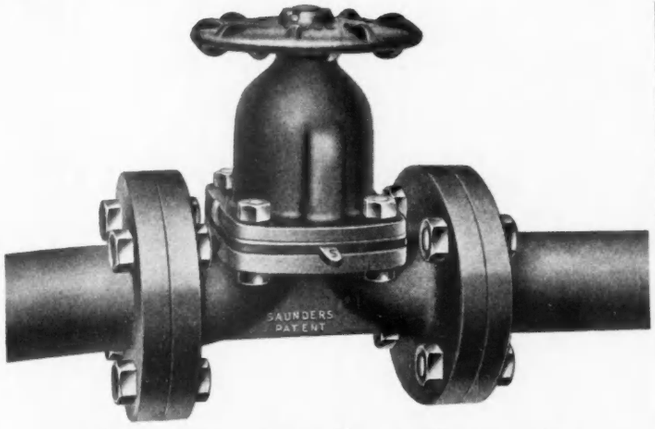

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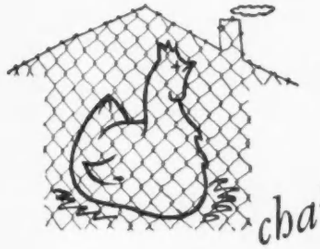

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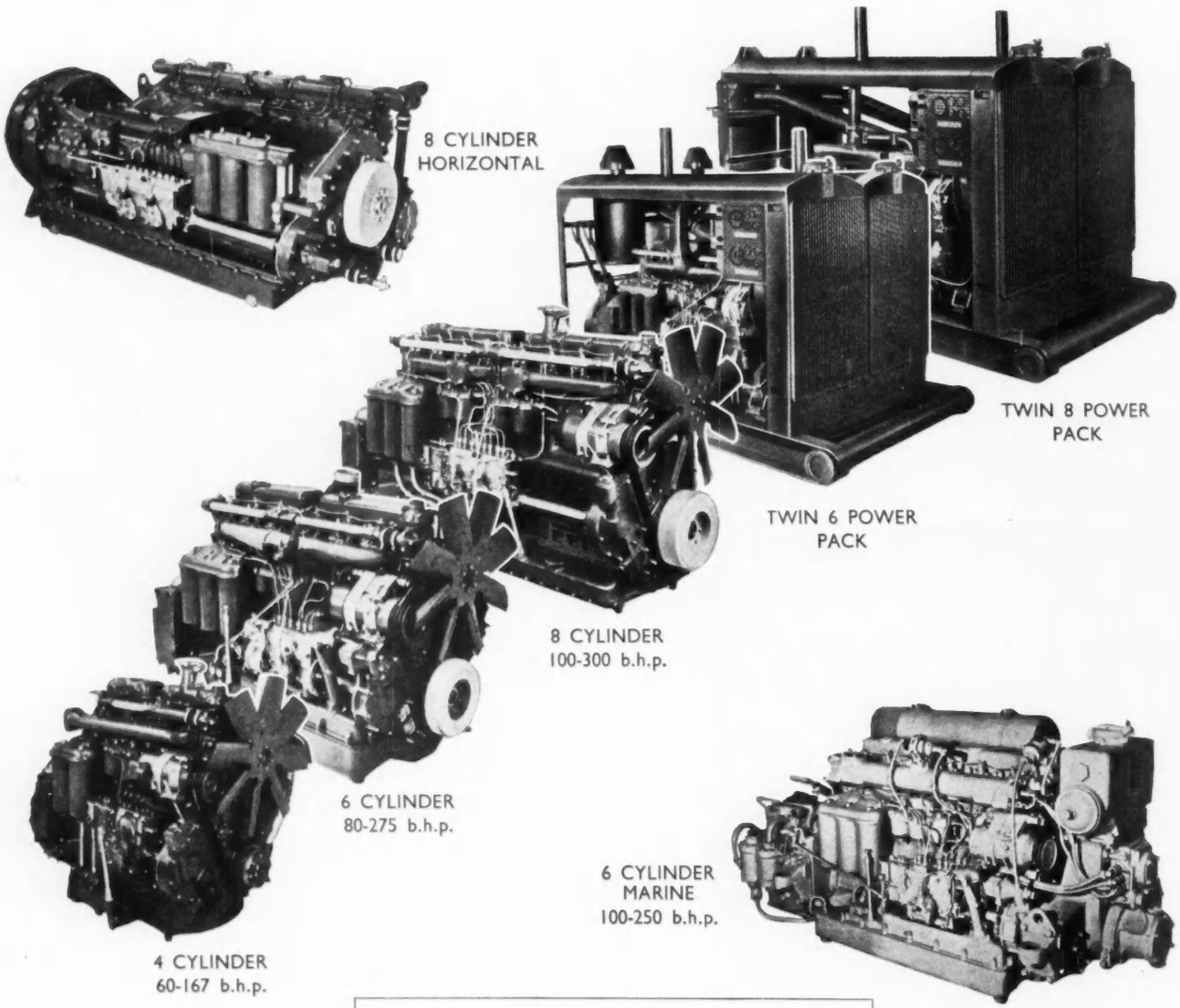

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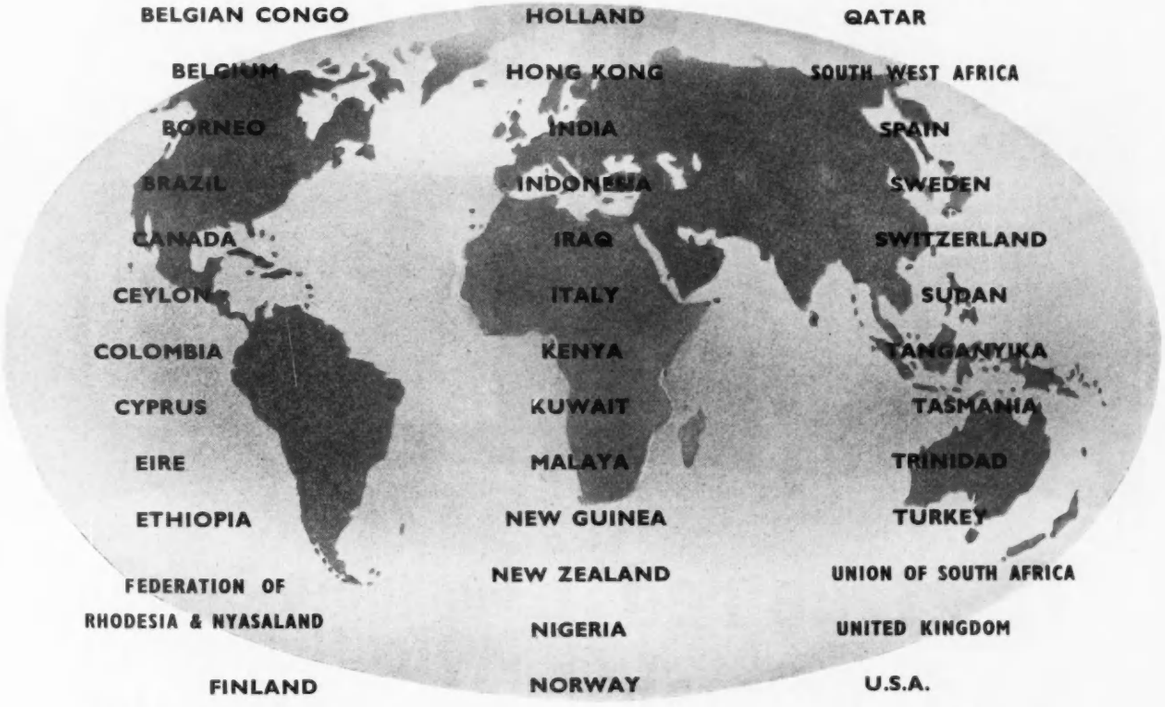

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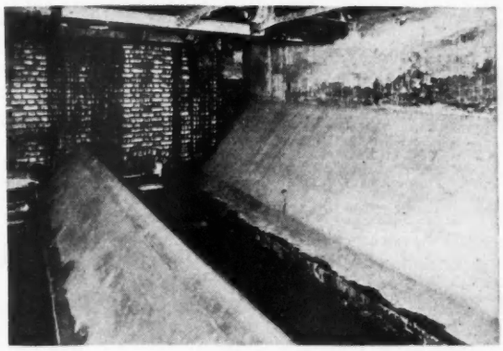
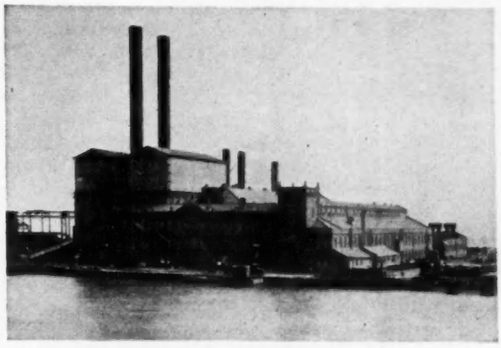
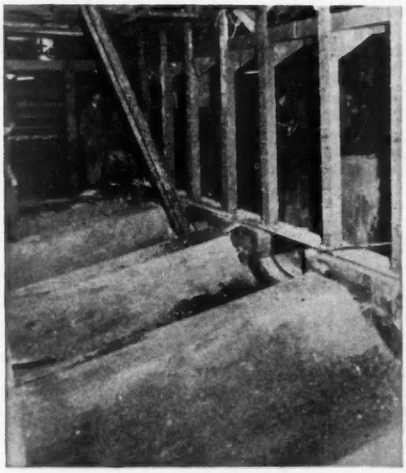


Clarence Dock Power Station. Hopper lined with ordinary Ciment Fondu concrete and the brickwork pointed with Ciment Fondu mortar.



Brighton 'A' Power Station. Ash pits and chimneys lined with ordinary Ciment Fondu concrete.



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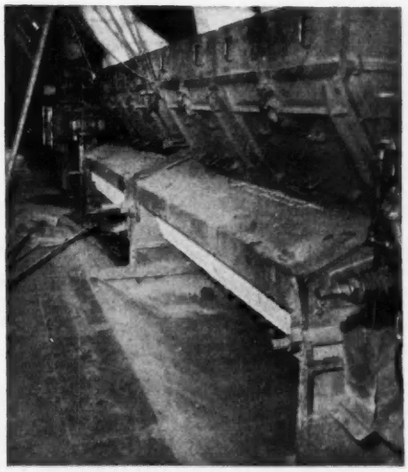

Acton Power Station. Hopper beneath chain grate stoker lined with ordinary Ciment Fondu concrete. Linings are 12' long by 2" and extend the full width of the grate.

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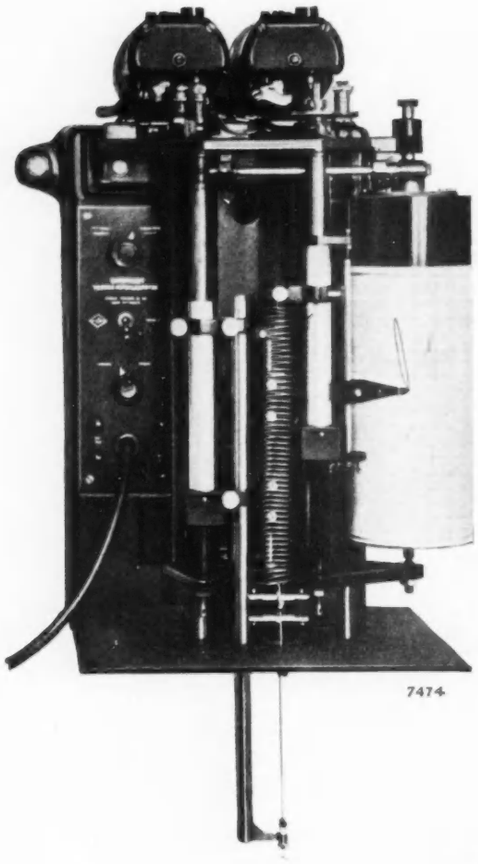
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GOODYEAR BELTS ARE LASTING ALMOST TWICE AS LONG . . .

Hot sinter, water-cooled from overhead sprays, being carried on Goodyear Style HRS belt, one of two used in Apex Plant.

Photograph by courtesy of the Appleby-Frodingham Steel Company

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ENGINEERING

An Illustrated Weekly Journal

Vol. 181 No. 4697 FEBRUARY 3, 1956

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INDEX TO "ENGINEERING"

Front Cover Photographs Preserved

The photographs used on the front covers of ENGINEERING have aroused considerable interest since they were introduced some years ago. In order to ensure that they are not lost when a volume of the editorial pages is bound, the six-monthly index is now printed with the front-cover photographs on alternate pages. The first new-style index, for Volume 179, January to June, 1955, is now available without charge from the Publisher, ENGINEERING, 35 and 36 Bedford-street, Strand, London, W.C.2. Readers already on the index mailing list need not re-apply.

FORTUITOUS AGGREGATES

AMONG American engineers about one in every four is engaged on research or development work. If this ratio from the most advanced industrial nation in the world is accepted as a rough and ready index of successful organisation in engineering, then it is useful to employ it as a yardstick by which to judge any given organisation. The ratio is one of a collection of broadly significant figures which have been compiled by the U.S. Department of Labor,* in compliance with an executive order of the President, "to provide comprehensive, up-to-date information on the nation's research resources and aid the National Science Foundation in recommending to the President policies to strengthen the country's research effort." Questionnaires were sent to a sample of 11,600 companies, and usable information was received from about 90 per cent. of them.

The figures on which the 1-in-4 ratio is based are: 408,700, total number of engineers employed, and 105,000 of them engaged on RD (the abbreviated title denoting research and development work). Chemists, as would be expected, have a much higher proportion—45 per cent. of their number—engaged on RD, and physicists and biological scientists have more than 60 per cent.

An interesting but difficult part of the inquiry was an attempt to discover how many people were employed on basic research. The main difficulty lay in defining "basic research," and in the differing interpretations which companies were liable to apply. Eventually basic or fundamental research was defined as "projects which are not identified with specific product or process applications, but rather have the primary objective of adding to the overall scientific knowledge of the firm." On this definition, only 4 per cent. of the total RD cost in American companies represented basic research. Is this a commentary on the cliché that Americans excel at production whereas the British lead in fundamental research? As one would expect, the chemical industry spent far more than any other industry on basic research; their total of 38 million dols. equalled the combined totals of the two next largest spenders in this field—the electrical equipment and aircraft industries. The figures for other industries are difficult to discuss as it is not clear, for example, what constitutes the "machinery" industry, but it is noteworthy that the whole of the primary metals industries spent very little more than an industry which is concerned with only one raw material, namely, rubber. This comparison holds whether we consider RD as a whole or basic research alone. The explanation is probably that a much higher proportion of research on metals is carried out by users (whose expenditure in this field is not revealed in the report) than is undertaken by users of rubber.

Inevitably it is the large companies which are responsible for most of the research and development work. But it is significant that in the United States the small companies carry out work of this kind. About 9,500 firms with less than 100 employees, and nearly 4,000 others with 100 to 499 employees, were found to be engaged on RD work in 1953. This evidence of the progressive outlook of such firms is a clear indication that a scientific approach, however modest in scale, is practicable for almost any firm, whatever its size. It is significant, too, that the number of small companies (less than 500 employees) engaged on research and development was greatest in the machinery industry. Throughout all industries, firms of between 500 and 999 employees appear to be relatively backward in their RD work. It may well be that many such firms have succeeded by the enterprise of one man; above 1,000 employees one-man leadership must be displaced by direction by team, and there is a greater chance that one of the team is research-minded.

Though all the RD work which was the subject of this survey was, by definition, work carried out by private industry, more than a third of it was done for the Federal Government, on either research and development or procurement contracts. Clearly, the American Government, as industry's biggest customer, exercise considerable influence on the work of American scientists and engineers. The Government were therefore wise to order this survey to be carried out. Now that they have the fortuitous aggregates, what will they do with them? How will they "develop and recommend policies to strengthen the country's scientific research effort?" The use made of this report will be watched with more interest than the report itself.

★ ★ ★

We offer our apologies to readers, contributors and advertisers for the reduced size of this issue. It is caused by the current dispute in the printing industry—a dispute to which we are not a party. At the time of going to press it was not known when the dispute would end. We regret that it is not possible to say whether next week's issue will appear, but we hope that we and other publishers of periodicals will soon be allowed to resume normal publication.

* *Science and Engineering in American Industry: Preliminary Report on a Survey of Research and Development Costs and Personnel in* 1953-54. Prepared for the National Science Foundation by the U.S. Department of Labor, Bureau of Labor Statistics. U.S. Government Printing Office, Washington 25, D.C. (30 cents.)

Weekly Survey

Cover Picture: *After the hot-squaring operation on superheater headers, illustrated in our cover picture of November 11, it is customary to remove as much mill scale as possible by applying jets of high-pressure water to the bore of the still hot header. The cover picture this week shows the end of the descaling operation, which is commenced when the header is at a bright-red heat.*

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Development Versus Progress

In the twentieth Parsons Memorial Lecture reported on another page in this issue, Sir Harold Roxbee Cox suggested that with the advent of the gas turbine a pattern in the picture of energy transmutation had been completed; there would appear to be no other practical engineering methods of driving shafts by means of heated fluids. Heat engines were of two main kinds—those in which the working fluid was heated by external means and those in which heat was supplied by combustion within the fluid itself; there was also the further division between the reciprocating engine and the turbine.

Thus of the four possible systems the gas turbine had been the last to become a practical proposition. The first had been the reciprocating steam engine, which in spite of the previous existence of windmills and water wheels had developed in advance of the fundamentally simpler turbine. Sir Harold submitted that this had been due to the need to raise water from mine workings, and the use of the reciprocating pump had led naturally to the development of a reciprocating prime mover, which had subsequently been adapted to give rotary motion.

Certainly the ideal prime mover to drive a piston pump is a piston engine, but is it not also possible that familiarity with one helped in the development of the other, so tipping the balance in favour of the reciprocating engine against the turbine? Thus it might be suggested that time and money spent on development work is a consolidating influence tending to oppose excursions in other directions. For example, as Sir Harold observed later in his lecture, the advanced stage of development reached by the internal combustion engine made it difficult at present to produce a competitive gas turbine for motor-car propulsion. In fact, the great strides achieved in the design of reciprocating engines might well have barred the progress of the turbine indefinitely, had it not been for the development of rotating electrical machinery. It is noteworthy that one of the companies which pioneered the gas turbine in this country is generally associated with electrical plant.

Thus a vested interest in the present can sometimes prove a barrier to the future where development is concerned.

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Interim Reports on Car Turbines

Two recent events throw light on the quickening tempo of development work on gas turbines for motor vehicles. The Austin Motor Company have publicised extracts from a talk given to Austin apprentices by Dr. J. H. Weaving, head of Austin gas-turbine research, and General Motors have exhibited in New York the first four-seater saloon designed entirely around a turbine power unit.

While maintaining that a turbine power unit could now be constructed suitable for modern production methods and current road conditions, Dr. Weaving emphasises that much work remains to be done on improvement of heat-exchanger and other component efficiencies before cost and fuel consumption can be brought within acceptable limits. The target is to produce a power unit with brake thermal efficiency equivalent to that of a modern Diesel engine.

The Austin turbine runs on Diesel fuel, partly because of British regulations which forbid use of paraffin in motor vehicles for tax reasons; partly to ensure easy availability of fuel through existing filling stations. When starting, the Diesel oil is fired by an electric igniter plug taking the discharge from a condenser. Two combustion chambers were used, at first, but it was not always possible to ignite them simultaneously. On one occasion a lot of neat fuel reached the turbine, where it emulsified, was ignited, and damaged most of the blades. Since then only one combustion chamber has been used. It would seem therefore that no progress has been made with the scheme which Austin patented some years ago, providing for several combustion chambers, and a compressor with a movable shroud, so that some chambers could be put out of action and compressor output reduced to improve fuel economy at part load.

The General Motors car, like the Austin, has its engine at the front. Twin circular intakes with silencers feed air to a single-stage centrifugal compressor, driven by a single-stage turbine at speeds up to 35,000 r.p.m., followed by a single-stage power turbine operating up to 28,000 r.p.m. Maximum operating temperature is quoted as 900 deg. C. and blades are made from GMR-235 alloy already in use for aero-engines. A rotor regenerative heat exchanger turning at 20-30 r.p.m. is said to utilise 80 per cent. of the exhaust gas energy, giving a fuel consumption equivalent to that of an American petrol car. The cooled gases pass away through the main chassis tubes.

The poor acceleration of a turbine unit at present seems likely to thwart hopes that it may eliminate the separate transmission system. The G.M. car implicitly recognises this fact by employing a fluid coupling and a four-speed planetary gearbox, which are mounted at the rear in unit with the differential to improve weight distribution.

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Strikes and Ships

The performance of the British shipbuilding industry in 1955 at first sight makes disquieting reading. Although new orders were at the highest levels since 1951 and over 1½ million tons above the 1954 total, output declined by some 13 per cent. compared with 1954 to 1·32 million gross tons, according to Lloyd's shipbuilding returns for December, 1955. Disputes and stoppages in the second half of the year are blamed for much of this decline.

Fortunately, German delivery dates are lengthening as order books become swollen, but British yards are still behind in quotations for delivery. The Shipbuilding Conference recently estimated that the proportion of new orders for export received during 1955 were only 8 per cent. of the total order book at the end of the year, compared with the previous year's proportion of 30 per cent. Delays due to strikes are thus doubly costly. They worsen delivery as well as raising costs and it is clear from the figures mentioned above that the shipbuilding industry has little margin in the export market for avoidable delays.

If the kinds of trouble with labour experienced in 1955 can be avoided in 1956 the shipbuilding industry can look forward to a record production year. Freight rates remain high under the stimulus of high levels of coal and ore imports and dry-cargo ships are ageing fast—a combination which must work to the benefit of the shipbuilding industry. But apart altogether from the trend of new orders in 1956, shipbuilders still have enough work in hand to keep them occupied for at least three years. The total U.K. order book at the end of 1955 was for 814 ships of 5,287,000 gross tons at a value of over £665 million. New orders placed in the last quarter of 1955 brought the total of new orders to 368 ships for the year, totalling 2,328,000 in all. At the moment, 51 per cent. of the order book is accounted for by tanker tonnage.

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Imperial College

Last year on June 24 we published a leader dealing with some belated opposition to the plans for expanding the Imperial College of Science and Technology; in it we observed: "It is right to permit public discussion of such an important proposal, but it is wrong for the discussion to be delayed nearly two years when the country can ill afford the slightest delay in the development of technical education facilities." The delay now appears to be halted. In reply to a question in the House of Lords on January 25, the Government announced its decisions, which mean that the full expansion planned in 1953 can now proceed.

The College has been asked by the Government to provide for 3,000 students. To meet this requirement plans have been prepared which entail a total floor space of 1,800,000 sq. ft., of which nearly 1,600,000 sq. ft. is on the central site. A statement from the College reported that it had been necessary in particular to make an extensive provision for engineering. Though about one graduate engineer in every nine was educated at Imperial College, most of the engineering buildings were over 70 years old and grossly overcrowded; large new buildings had therefore been proposed for civil, mechanical and electrical engineering, in addition to the building for aeronautical and chemical engineering already nearing completion. The student population of the College has already risen by 25 per cent.

The plan has involved a complicated rebuilding programme, and in spite of opposition, the Government have decided that the retention of the "Colcutt" building, which fronts Imperial Institute road, would serve as a major impediment and reduce the number of students that could be accommodated. Ruthlessness has been necessary, and there can be little doubt that the call for engineers to carry out the nuclear power programme and the recent news of technological education in Russia have influenced and hastened the Government's decision.

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A.C.V. and the Labour Force

Lord Brabazon of Tara had a good deal to say last week, at the annual meeting of Associated Commercial Vehicles Limited, about the shortage of skilled labour and the need to foster recruitment of engineering student apprentices. A high proportion of the present skilled labour force in the company's employment came from the men trained by the company but the small difference which now exists between skilled and unskilled wage rates does not encourage a boy to learn a craft. The problem of maintaining an adequate supply of trained men is clearly one of this company's preoccupations.

For A.C.V. this recruitment problem is having important consequences on policy. It is helping the group to make up its mind to go in for increased mechanisation in an effort to reduce its internal costs per unit of output and to spread its labour force over a larger output. A.C.V., like others, seem to be caught between the upper and nether millstone of requiring more skilled workers and yet having to spread rising wage costs over a higher output.

The company are pressing on with the policy of diversification and increased mechanisation to reduce the pressure of rising costs (including external costs) on profit margins. Although the group is probably best known for the work of its Body Building Division, (which has in the last financial year achieved an encouraging improvement in turnover and profits), the group is now becoming very diversified. Impressed by the fact that the productive capacity of the country for bus body building exceeds demand, its activities have now spread to hire purchase and estate management, aero-engines, gears and machine tools and (jointly with Leyland Motors Limited), into lightweight Diesel train units. The orders on hand at British United Traction Limited, which is the company formed to deal with this side of the group's activities in partnership with Leyland, stand at over £2·5 million. Through this subsidiary, A.C.V. are now geared to some extent to the modernisation programme of British Railways.

More than 60 years ago Nansen's "Fram" was equipped with a generator driven by a wind machine (the sails of which are shown in this illustration) for supplying the expedition with electric light.

Book Reviews

WIND MACHINES NEED MORE THAN WIND

The Generation of Electricity by Wind Power. By E. W. GOLDING. *E. and F. N. Spon, Limited, 22 Henrietta-street, London, W.C.2.* (50*s*.)

Between the idea
And the reality
Between the motion
And the act
Falls the shadow

(T. S. Eliot, *Collected Poems*, 1909-25, Faber & Faber.)

Most engineers retain on their bookshelf a few survivors from the text-books which came to them in student days. They have survived because the information they contain is subconsciously recognised as being fundamental and therefore ageless. Once in a decade they earn their keep by restoring to the mind's eye the outline of a once hard worked formula.

Mr. Golding's earlier text-book, *Electrical Measurements and Measuring Instruments*, has a high survival rate: now he has given another to posterity. To write a text-book on wind-power at the present time is an act of faith in the future of the subject. Were he not so modest, Mr. Golding might have reminded us, as did St. Luke, of his "former treatise" and added, again with Luke, that "some believed the things which were spoken and some believed not."

To write a popular book must have been tempting: to write a thesis would have been all in the day's work. The chosen course was the right one but a text-book can be dangerous in unskilled hands. Should another edition appear perhaps we can have a re-written preface with a suitable warning note. For those who have to design wind-plants, the reading of this book could make their task seem too easy. For the development officers of under-developed countries there is a risk of some planning for which the necessary equipment may not be forthcoming. Chapter 17 makes the choice of windplant seem as simple as a decision between a Pelton, Francis or Kaplan water turbine. How strange it is that so many people believe that this happy position has already been reached with wind-plants. An example of this kind of thinking may be salutary. An inquiry was recently made for wind-driven generating equipment for a under-developed part of the Commonwealth. The inquirer was told by a manufacturer that to the best of their knowledge, no suitable equipment was on the market but that something might be done if the inquirer would indicate, for this and the other territories under his care, the likely demand and the price per installed kilowatt which would be economic. The reply given to the manufacturer expressed shocked surprise at the hint of collaboration implied in the question and suggested that if an acceptable price was known in advance the supplier would be tempted to adjust his price accordingly and to the detriment of his competitors.

What, after all, is the position ? The organisers of the Trans-Antarctic Expedition inquired recently regarding the availability of British-built wind plants which might be used to supplement and economise oil fuel at the two base camps. No machines larger than 500 watts were available. Sixty-two years ago, Nansen sailed North in the "Fram" with a wind-plant amidships, and through the dark winters of 1893-94 and 1894-95, he and his companions enjoyed the blessings of electric light.*

It is six and eight years respectively since two British companies embarked on the construction of 100 kW prototypes. One has only recently commenced operation. The second lingers untested on a lowland field. In Denmark, in the year 1944, there were 88 wind-power stations which produced, in that year, 3 million kWh. By 1947 the output of wind-generated electricity had fallen to near half this figure and the principal suppliers of the plants dropped the business. There has recently been a revival of interest but on nothing like the scale of the war-time development. Again and again in the long history of windmills, success has been achieved when the need was sufficiently pressing, and pressing directly upon those in a position to take action. Demand from "the man next door" has never stimulated the necessary exercise of brains and capital.

It is to be hoped that those who have undertaken to build the two British prototypes have some plans which they have not yet made public. They must have spent much more than they are likely to receive from the authorities who commissioned the machines and many well-wishers throughout the world, not least in the poorer countries, will desire them a fair return for their enterprise in the common good. How greatly the task of the manufacturer would be simplified if the customer would meet him half way, by saying, for example, "We can afford to pay £P per kW and we can wait T years; if you can meet these requirements we will order N machines." Without close collaboration in development between Commonwealth countries it is difficult to see how such an assurance can be given. Thus, a vicious circle is created. Orders cannot be placed until production is assured and production cannot be planned without some assurance as to quantities and prices. The *New Commonwealth* is currently publishing a series of articles on just this type of collaboration. If the idea takes root, as it surely must, there is no one more suited than Mr. E. W. Golding to co-ordinate and inspire.

The future of this fine text-book is inseparable from the future of wind-power. If the project succeeds it will be due in great measure to the work of the author and his colleagues.

* Nansen wrote in his diary on October 25, 1893, "It is quickly getting darker, the sun sinks lower and lower every time we see it; soon it will disappear altogether. The long dark winter is upon us. . . . There is now a south-west wind and the windmill has been tried at last and works splendidly. We have beautiful electric light to-day although the wind has not been specially strong. 5-8 metres per second. Electric lamps are a great institution. The light acted on our spirits like a draught of good wine." Nansen's windmill had four blades and recalled, in appearance, La Cour's machine (Plate V in the book). The "Fram" had a 36 ft. beam and, from illustrations, the windmill appears to have swept a circle of 25 ft. The generator was between decks, driven through shafting and bevel gears. Trouble with the gearwheels developed after fifteen months but Nansen was soon able to record that the machine was once again "running as smoothly and steadily as guttapercha." The illustration of the Fram reproduced above is taken from Nansen's *Farthest North* (Constable, 1897).

★ ★ ★

BOOKS RECEIVED

Some of the books noticed here are selected for extended review in ENGINEERING.

The Mining and Dressing of Low-Grade Ores in Europe. Technical Assistance Mission No. 127. *Organisation for European Economic Co-operation, 2 Rue André-Pascal, Paris 16e.* (900 francs); and *H.M. Stationery Office, Kingsway, London, W.C.2.* (18*s*.)

This book constitutes the report of a mission composed of 24 scientists and technicians drawn from ten European countries and the United States. Their task has been to examine the facilities available for research, and the practical results achieved, in the mining of low-grade ores in the United Kingdom, Sweden, Germany, Italy and France. The report is divided into three parts, namely: (*a*) a general discussion of the problems connected with the improved exploitation of low-grade deposits, (*b*) a survey of developments in research and practical working which have come to the mission's notice, and (*c*) details of plants and laboratories visited and a summary of discussions held during the tour.

Handbook of Pneumatic Equipment. Second edition. Compiled and published by the *British Compressed Air Society, 32 Victoria-street, London, S.W.1.* (20*s*.)

This handbook is intended for potential users at home and overseas, to enable them to recognise and appreciate various types of air compressors, pneumatic tools and ancillary equipment available. It covers general design and gives details of testing methods to be employed. There are sections on spraying equipment, percussive and rotary pneumatic tools, various pneumatic machines, foundry moulding machines, rock drills, concrete breakers, picks, etc., vibrators, pumps, hoists, cement guns, pneumatic sewage ejectors, aircraft equipment and accessories. It includes a table of air consumption of tools and appliances and lists the data required for ordering. A buyers' guide is included together with a classified list of products.

Principles of Helicopter Engineering. By JACOB SHAPIRO. *Temple Press, Limited, Bowling Green-lane, London, E.C.1.* (55*s*.) (Reviewed on page 74, in the issue of January 20.)

Swiss-Type Automatics. Parts 1, 2 and 3. By G. A. W. MORGAN. Machinery's Yellow Back Series Nos. 36, 36a and 36b. *Machinery Publishing Company, Limited, National House, West-street, Brighton, 1.* (4*s*. each.) (Reviewed on page 74, in the issue of January 20.)

The Engineering Outlook—4

AGRICULTURAL MACHINERY

MARKED DECLINE IN LAST SIX MONTHS

Output of agricultural machinery in the year to June 30, 1955, justified manufacturers' predictions, though preliminary figures for the second half of 1955 suggest that the optimum level of farm mechanisation may now have been reached. In the year to June 30, 1955, production of agricultural tractors in particular (Fig. 2) showed a marked increase of some 14½ per cent. over 1953–54 and, although the expansion is somewhat less for agricultural machinery as a whole, increases in exports helped considerably to maintain and in some cases expand production.

The trend of production over the last few years is shown in the diagrams which accompany this article. While production figures are not available since June, 1955, there is reason to believe that output for the calendar year 1955 was lower than for the twelve months to June. Preliminary estimates show that production of agricultural machinery, which in the first half of 1955 was running at about 20 to 25 per cent. above the levels recorded in the last half of 1954, had fallen by the second half of 1955, to between 25 and 30 per cent. below the comparable period of 1954. Home sales of farm machinery fell sharply during the last half of 1955, although exports have not been affected to such a marked degree. In the first half of the year, exports of agricultural machinery were about 25 per cent. up on the last half of 1954, while in the second half of 1955, after a sharp drop in August, export sales were generally comparable to the same period of 1954.

HOME DEMAND

Nevertheless, output for the calendar year 1955, was still substantially above the previous year's total for many types of farm machinery, although indications are that the credit squeeze, together with high interest rates and other restrictions on trade, are exerting a restraining, influence on the volume of home trade, while exports of agricultural tractors, reapers and combine harvesters showed a small decline in 1955 (Table III). Many companies also attribute lower output in the second half of 1955 to transport strikes in the middle of the year, which are said to have restricted supplies and hampered both production and distribution.

In any case, some fall in home demand was to be expected. Indeed at first sight it is strange that the fall in demand was held off until the last half of the year. Although it was estimated that the annual price review in March 1955 would add some £30 million a year to farmers' incomes, this was largely nullified by two wage awards during the year which resulted in increases in overtime rates, payment of full wage rates to agricultural workers at the age of 20 and a rise in the basic wage from 127*s.* to 135*s.* Cost of machinery, foodstuffs and fertilisers also rose under the influence of rising material prices and freight charges, while declining profit margins of companies manufacturing agricultural machinery forced many of them to raise their prices.

Meanwhile, the acreage under crops in the 1954/55 season, declined by some 5 per cent. It might therefore be expected that the demand for agricultural machinery would at last follow the trend which economists have been confidently predicting for the last five years, and decline in 1955. In fact, the demand for tractors in particular has confounded all predictions, and while implement manufacturers have had mixed fortunes, they have in general as yet no cause for complaint. Output of ploughs, corn drills and milking machinery declined, but production of disc harrows, potato spinners, mowers and combine harvesters continued to expand at least during the first half of the year, and increased exports of most types of equipment helped to maintain overall output at levels above those recorded in 1954. Meanwhile, it has been suggested that further introduction of dairy machinery at home is being held up by insufficient rural electricity supplies, and the future may well see expanding sales of dairy equipment as schemes announced in 1955 by the Central Electricity Authority come into effect.

What then, was the reason behind this continued rise in demand for agricultural machinery, particularly tractors, and, more important from the point of view of manufacturers, was it soundly based? Probably the main reasons can be found in the peculiar sensitivity of the farming community to market trends and crop figures. 1955 was a remarkably good year as regards weather. Holidaymakers and farmers alike rejoiced in a fine summer following a humid spring and preceeding a dry harvesting season. The result was that, although the acreage under crops declined by some 5 per cent., yield per acre rose sharply, and cereal production, for example, was some 4 per cent. above that of the previous year. The state of confidence which this produced among farmers most certainly contributed in no small degree to the maintenance of tractor sales. It is probable that the other main reason was the continued drift of labour away from the land. The official statistics published by the Ministry of Agriculture showed that in June, 1955, the number of regular male workers on the land was 439,000 compared with 463,000 in June, 1954, and 475,000 in June, 1953. It has been estimated that an average of 60 workers per day leave the land for industry and the reason is not far to seek. In an era of over-full employment, labour is bound to move away to better paid jobs, and while earnings and conditions have improved in agriculture, they have not done so relative to manufacturing industry—and constructional activity in particular—and a wage differential of at least 10 per cent. continues to exist as between farming and other primary and manufacturing industries. To maintain production it is therefore essential for farmers to replace men with machines. This has undoubtedly been assisted by a change-over to the Diesel-engined power unit, which represents a considerable saving in operating costs over the petrol driven engine, and also by the greater efficiency and variety of uses to which a tractor can now be put.

DEGREE OF MECHANISATION

The changing face of agriculture—towards extensive mechanisation—and the declining labour force, has resulted in such fundamental changes over the last 15 years that the industry as a whole bears no comparison with pre-war

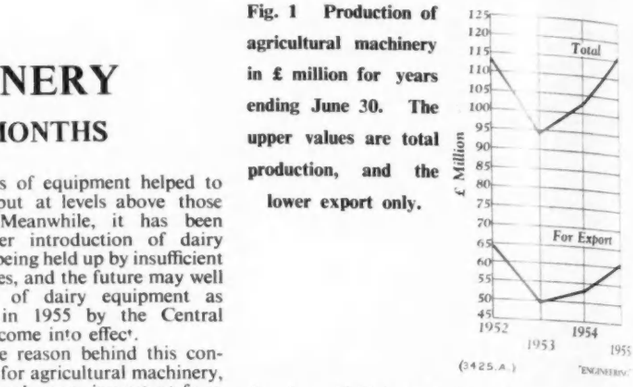

Fig. 1 Production of agricultural machinery in £ million for years ending June 30. The upper values are total production, and the lower export only.

farming. British agriculture is now the most highly mechanised in the world, there being, for example, one tractor to every 60 acres, compared with the U.S. ratio of 1 to 118, and British farmers are estimated to spend about £50 million a year on new equipment. The agricultural machinery industry has been relatively prosperous for the last year or two but it may be asked how much longer this is likely to continue. The second half of 1955 may well have seen only the first signs of decline, and the present extent of mechanisation in itself is a warning sign to producers of farm equipment. Farmers have been making money and buying machinery, but agriculture is a seasonal industry affected by influences which do not touch manufacturing industry as a whole. Prices of much agricultural produce tend to find their own level on the market and are not automatically increased as a result of increased costs. Although guaranteed prices offer security for a wide range of farm produce, an additional factor is that total farm incomes are still dependent to a large extent on the harvest yields; it needs only one bad season to upset the plans and prospects of most farmers. Meanwhile there is strong pressure on the Government for a reduction in subsidies to some sections of agriculture, and this may be reflected in this year's price review. It needs only a slight setback in agriculture to affect the market for farm machinery, and it seems probable that bearing in mind all these factors, home demand for agricultural machinery will level off, if not actually decline, within the next year or so.

In July, the British Productivity Council expressed doubts as to whether farmers are making efficient and adequate use of the machinery purchased since the war. Revealing figures were included in their Review of Productivity in Agriculture published in July last year. While expenditure on equipment by farmers has risen by 900 per cent. since the war, the overall volume of food production has expanded by only 53 per cent. Even allowing for increased prices of machines, the declining labour force, and the fact that there are many old machines which are now never used, this still leaves some gap between the two figures. The trend so far has been largely to substitute machinery for

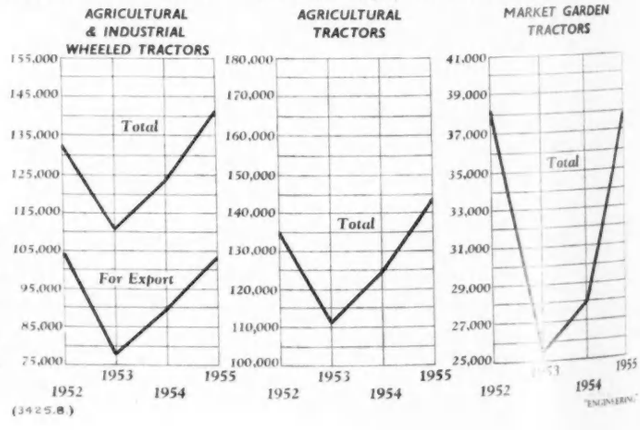

Fig. 2 Agricultural and horticultural tractors made in the United Kingdom during the last four years.

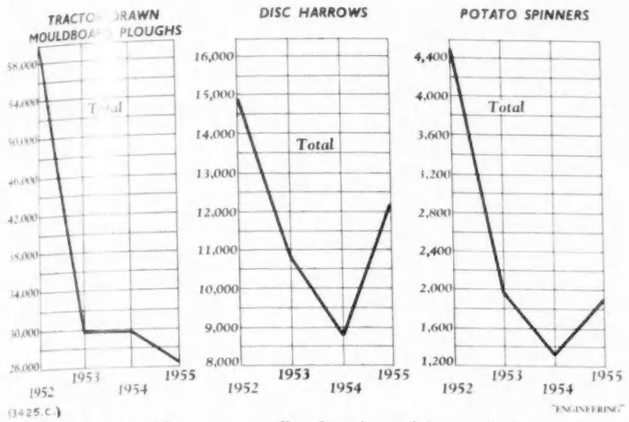

Fig. 3 [Mould board ploughs, disc harrows and potato spinners made in the United Kingdom since 1952.

animals and men without necessarily changing farming methods. It is easy to conclude that agricultural efficiency could be considerably improved, but it may not be possible without radically altering the structural nature of British farming or, more especially, bringing about greater co-operation between individual farmers. A squeeze in guaranteed prices might well provide the necessary incentive. The only inference to be drawn from this is that demand for new equipment might well drop sharply, particularly given an effective credit squeeze in 1956, and something of the sort may already have been taking place in the last half of 1955. It would certainly appear that farmers have been making do with ageing implements, for expenditure on equipment other than tractors declined last year, while production of ploughs and corn drills fell accordingly. While Diesel-driven tractors can quickly pay for themselves on fuel saving alone, this is not the case with a large proportion of other agricultural machinery.

NEED TO SELL ABROAD

Producers of agricultural machinery are aware of this trend and are intensifying their efforts to sell more abroad. In 1955, exports accounted for 52½ per cent. of the total output of agricultural machinery and equipment, while the proportion of tractors going abroad was even higher at 73 per cent. The achievement of the large manufacturers, particularly of tractors, is impressive. Recent orders for 500 tractors from Finland and 600 from Sweden made 1955 a record year for David Brown (Tractors) Limited. Meanwhile, Belgium bought 900 David Brown tractors in 1955, while in addition to a recent order for 200 tractors, Italy has ordered 105 binders worth more than £25,000. Earlier last year, David Brown was in the news in connection with extensive orders from South America. In December, 1955, nine out of ten tractors produced by the International Harvester Company of Great Britain, Limited, were shipped abroad, while to the year ended October, 1955, 33 per cent. of the company's total sales were made in the export market. An interesting aspect of this company's effort abroad is the discussion now proceeding with a Chilean firm to produce tractors at a plant near Santiago, while David Brown last year established a factory at East London in South Africa. The Ford Motor Company, Limited, have been particularly successful in the American market in the face of growing competition from the reviving United States agricultural machinery industry, and in May arrangements were made to sell British-built Fordson tractors in Western Germany. This is a particularly noteworthy achievement since apart from the United Kingdom and the United States, Germany is the biggest producer of tractors in the world. In November it was announced that a Jugoslav export order worth nearly £1 million had been secured by F. Perkins, Limited, of Peterborough, who undertook to supply agricultural tractor engines to Industrija Motora and Industrija Traktora. These engines will be installed in Ferguson tractors. F. Perkins were also successful recently in securing a 1 million dollar order for the supply of Diesel engines to a Canadian tractor company, of which deliveries have already begun. Massey-Harris-Ferguson, Limited, secured a large order amounting to £4¼ million from Jugoslavia for tractors in October, while the president of the Canadian Massey-Harris-Ferguson company went to Moscow in October, 1955, to investigate the possibility of exporting agricultural machinery to Russia following continuing sales of International Harvester tractors and equipment to that country. While Massey-Harris have sold agricultural equipment to Russia before, the last shipment was in 1917, and if this visit is successful the Soviet market should provide a valuable outlet for further development of the export trade.

While the achievements of individual companies are impressive, however, on examining the overall figures for exports of tractors, there is obviously little cause for complacency. As shown in Table I the quantity of tractors sent abroad was 2½ per cent. lower than in 1954, although the value rose slightly. This is in part a reflection of favourable trends in the terms of trade, although in 1955 some of the factors affecting the overseas market were beyond the control of individual companies at home. Australian import cuts, for instance, effectively reduced the largest single market for agricultural tractors, and with them came a fall in demand from New Zealand. Sterling area sales as a whole have, however, been more than maintained as a result of intensive selling in Africa, particularly in the Union of South Africa and Kenya. Demand in Europe levelled off, despite record orders from Finland and increased exports to the Netherlands, Belgium and Spain. The most significant reductions are evinced by Denmark, France and Italy, the latter probably as a partial result of the Vanoni 10 year plan for encouraging domestic production, while French domestic output of agricultural machinery expanded rapidly during 1955. Reduced sales to North America are not the result of a decline in U.S. farm incomes as suggested in some quarters, but a sign of the revival in the U.S. agricultural machinery industry. More intensive selling in this market would reap rewards, as many North American farmers are finding it necessary to replace ageing machinery. U.S. manufacturers are finding it profitable to

TABLE I.—UNITED KINGDOM: EXPORTS OF AGRICULTURAL TRACTORS, BY COUNTRY OF DESTINATION

	Quantity (Numbers)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
South Africa	5,948	8,001	10,164	2,447	3,489	4,622
Rhodesia and Nyasaland	514(a)	1,004	1,303	242(a)	453	664
Kenya	393	553	1,027	193	316	564
India	968	1,877	2,042	376	745	908
Australia	14 845	19,198	18,194	5,255	7,061	6,617
New Zealand	7,646	9,133	5,759	3,096	3,519	2,389
Canada	3,889	4,203	2,483	1,803	1,622	1,082
Other Commonwealth Countries	2,746	2,714	3,119	2,046	1,619	2,097
Irish Republic	3,739	4,625	3,892	1,572	2,112	1,896
Finland	1,835	2,937	7,597	812	1,413	3,397
Sweden	11,202	7,152	6,094	4,433	2,965	2,694
Norway	3,584	4,762	3,848	1,354	1,934	1,637
Denmark	8,412	8,043	6,470	3,181	2,972	2,490
Netherlands	1,932	2,817	3,717	819	1,143	1,570
Belgium	1,793	1,627	2,115	725	658	921
France	6,140	4,038	2,785	2,431	1,545	1,311
Spain	1,250	1,699	2,034	822	900	1,032
Italy	4,636	4,396	3,358	2,311	2,139	1,607
Jugoslavia	111	20	n.i.	118	45	n.i.
Greece	206	185	n.i.	100	100	n.i.
Turkey	813	1,274	558	683	799	378
Algeria (b)	1,393	999	959	784	661	621
Egypt	385	446	n.i.	140	200	n.i.
U.S.A.	3,942	7,955	5,463	799	3,272	2,074
Cuba	370	205	420	179	106	231
Brazil	532	762	n.i.	247	373	n.i.
Uruguay	389	1,220	449	227	693	252
Other Foreign Countries	5,887	7,812	13,104	3,320	4,679	7,364
Total	95,500	109,657	106,954	40,515	47,533	48,418

(a) Southern Rhodesia. (b) Including French Morocco. n.i. Not indicated separately.

TABLE II.—UNITED KINGDOM: EXPORTS OF AGRICULTURAL MACHINERY OTHER THAN TRACTORS, BY COUNTRY OF DESTINATION

	Quantity (Numbers)			Value (£1,000)		
	1953	1954	1955	1953	1954	1955
South Africa	64,075	62,316	73,695	863	862	1,068
Rhodesia and Nyasaland	16,330(a)	22,287	22,809	211(a)	304	335
Kenya	21,566	18,270	24,840	293	321	422
India	10,719	14,469	12,904	151	197	187
Ceylon	7,308	2,598	n.i.	112	57	n.i.
Australia	139,534	174,507	162,521	2,440	2,985	2,993
New Zealand	74,020	69,116	55,031	1,170	1,164	1,021
Canada	53,647	49,230	44,323	498	467	449
Other Commonwealth Countries	63,762	53,443	62,387	994	990	1,040
Irish Republic	127,640	172,850	161,800	1,408	1,989	1,985
Finland	7,067	22,436	49,175	155	474	935
Sweden	18,504	22,674	29,268	332	415	529
Norway	8,664	11,232	10,507	175	227	225
Denmark	21,228	27,791	12,887	333	446	231
Netherlands	25,872	28,869	31,156	324	376	467
Belgium	18,296	15,696	18,536	247	218	281
France	71,486	31,509	29,169	1,315	517	516
Algeria (b)	21,636	17,536	15,344	303	281	254
U.S.A.	52,567	47,907	42,486	639	531	592
Brazil	8,722	5,409	n.i.	74	54	n.i.
Turkey	40,804	680	464	819	33	13
Other Foreign Countries	152,671	210,242	254,282	2,296	3,304	4,221
Total	1,033,058	1,081,067	1,114,584	15,152	16,212	17,764

(a) Southern Rhodesia. (b) Including French Morocco. n.i. Not indicated separately.

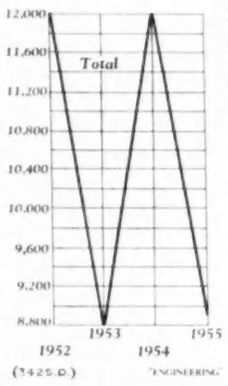

Fig. 4 Number of milking machines made in the United Kingdom since 1952.

TABLE III.—UNITED KINGDOM: EXPORTS OF AGRICULTURAL MACHINERY

	Quantity (Numbers)			Value (£'000)		
	1953	1954	1955	1953	1954	1955
Types other than tractors:						
For preparing and cultivating the soil:—						
Ploughs—						
Mechanical power	167,142	166,054	176,358	1,631	1,592	1,926
Other sorts	251,995	277,208	278,341	2,819	3,203	3,415
For harvesting, threshing and sorting:—						
Hay and grass mowers (including mowing attachments to tractors) other than rotary blade type	50,433	51,639	52,135	825	890	919
Reapers, binders and threshers	7,802	12,771	11,411	89	148	170
Combine harvester-threshers	153,451	147,428	143,918	3,196	2,048	2,696
Other	162,118	169,130	186,925	2,334	2,564	2,950
Dairy machinery	25,710	28,235	35,955	1,122	1,382	2,009
Lawn Mowers	124,857	140,741	139,723	1,542	1,827	2,034
Sheep shearers and clipping machines	3,527	3,632	4,259	209	246	296
Other descriptions	86,023	84,229	85,559	1,387	1,411	1,349
Total	1,033,058	1,081,067	1,114,584	15,152	16,211	17,764

introduce new models incorporating refinements such as power steering, improved hydraulic controls, torque converters and other devices making for easier operation and greater efficiency, and it is towards introducing new and improved models that the British agricultural machinery industry must look if it is to maintain its place in the North American market.

While exports of tractors are important and will become more so with an inevitable decline in demand from home sources, implement manufacturers are finding it even more urgent to expand sales in the export market. In 1955, declining sales at home forced manufacturers into the overseas market to such an extent that exports of agricultural machinery reached the highest levels since the boom year of 1952. Exports of agricultural machinery in the calendar year 1955 were 31 per cent. up on 1954 levels. Producers of machinery other than tractors expanded their sales in Africa, held their own in the difficult Australian market, and were, from the figures given in Table II, competitive in France.

FUTURE MARKETS

The future, then, would seem to rest to a major extent upon how manufacturers of agricultural machinery manage to hold their own in the export market. Up to 1955 the record has been good, but conditions abroad must be watched carefully, and present indications are that the overseas market will become more difficult and more highly competitive as a result of increased domestic production and intensified competition from Germany and the U.S.A. At present, British manufacturers can offer advantages both in price and quality, but foreign countries are steadily building up their own industries and it is probably to hitherto underdeveloped countries that British manufacturers must look for their main export outlets. Further trade liberalisation could help to a large degree, but any further tendency towards lifting restrictions will be limited by the desire of most developed countries to check the present world-wide boom from turning into large-scale inflation. In Europe, France in particular, helped by subsidies and restrictive import licenses, has been expanding rapidly in the field of agricultural machinery. From a pre-war total of 200 tractors a year, production expanded in 1954 to 40,000 and in 1955 was estimated at 50,000 tractors. Meanwhile, German competition is likely to become even more evident in 1956. Mechanisation of German farms has expanded very rapidly during the last 4 to 5 years, and experience in supplying this demand, together with rapid expansion of manufacturing capacity, presages a period in which German manufacturers will become formidable and growing competitors.

The recovery of the U.S. industry, with a consequent shrinkage of imports, has not been helped by tariff restrictions so much as by improved machines and rising replacement demand. Britain therefore will face competition on an increased scale from Germany, the United States and France in 1956, and it will be necessary to make even greater efforts to enter fields hitherto considered unimportant. The Middle East in particular is a valuable potential market in view of the large amount of financial assistance from abroad and the rapid industrialisation of Egypt, Iraq, Turkey and Israel. It is particularly disturbing to note in this connection that sales of tractors have declined in this area. Egypt took 446 British tractors in 1954, but sales in 1955 were apparently not sufficient to be shown separately in the Trade and Navigation Accounts. Exports fell to Algeria and Morocco, probably as a result of increasing French competition, while exports to Turkey also show a marked decline. U.K. exports of agricultural machinery other than tractors to Turkey amounted in value to £819,000 in 1953, but declined to £33,000 in 1954 and only £13,000 in 1955.

While the South American market has by no means been neglected by individual manufacturers, demand from Brazil as shown in Tables I and II continues to decline, and a lot more effort is needed if the United Kingdom is to hold and improve the valuable South American market against competition, in particular from Germany and the United States. An appreciable demand undoubtedly exists in such countries as Peru, and it was pointed out last November by the Board of Trade that "there is reason to believe that a good market can be created for U.K. machines of the right type providing prices are competitive, adequate publicity is arranged and efficient servicing facilities are made available." A good deal of the success of United States exporters in this market is attributed to their carrying large stocks and supplying servicing facilities.

Small countries such as Ireland should also be watched. Sales to Eire declined slightly last year, but this small market is likely to become profitable as concessions to farmers announced in the Eireann budget early in 1955 begin to take effect.

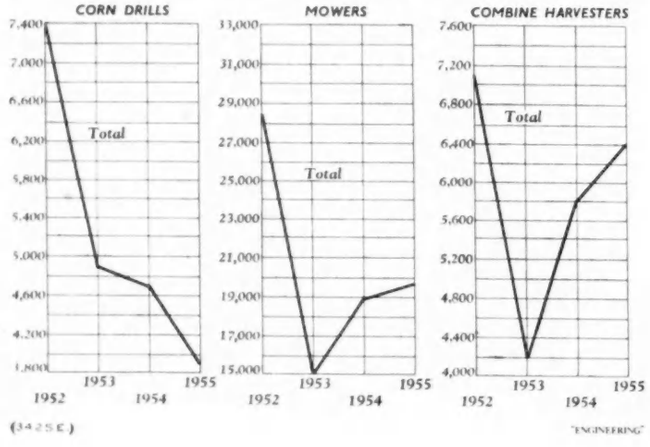

Fig. 5 Harvesting machinery made in the United Kingdom during the last four years.

COMBINATION EQUIPMENT

While much emphasis has been placed on the export market in this article, this may be excused on the grounds that export earnings constitute a major proportion of the total income of agricultural machinery producers. In turning to the home market the most interesting development over the last few years has been the action of large producers in forestalling possible difficulties ahead by extensive combination and co-operation. In 1953, the Massey-Harris-Ferguson merger was the biggest item of news, and this was followed late in 1954 by the arrangements under which the Ford Motor Company, Limited, and Ransomes Sims and Jeffries Limited, undertook to integrate their design and manufacturing capacities with a view to rationalising throughput and making output more efficient, cheaper and more productive. Ransomes Sims and Jeffries were able to bring their implement factory at Nacton into full operation in January, 1955, while an additional factory is now being built in collaboration with Davey, Paxman and Company, Limited and Ruston Hornsby Limited. The company is confident that any increase in capacity and output will be fully justified by rising demand. In 1955, the David Brown Corporation acquired a controlling interest in the large agricultural company of Harrison, Macgregor & Guest Limited. While these mergers could reflect a possibility of difficulties ahead, they also presage an era of intensifying competition between manufacturers of agricultural equipment.

Meanwhile, developments and improvements have been made in various fields of machinery throughout the year. In September, 1955, Massey-Harris-Ferguson demonstrated equipment for puddling paddy fields—a tractor with paddle-like extensions to the wheel, drawing a disc harrow and levelling board. This is an example of a trend which has become increasingly notable over the last few years towards integrating tractors and other implements to provide complete "systems" of farm mechanisation. An interesting facet of this trend was also demonstrated in the United States at about the same time. Called the "Wonsover" this is a tractor-driven combination which ploughs, harrows, plants and sows, and packs soil in a single operation, by utilising a series of whirling hammers which dig the ground, break up clods (and rocks) and kick soil into the air where it can be mixed with a liquid weed killer. The most important occasion for the display of new

developments made by British manufacturers was the Smithfield Show in December last year. It was in fact criticised in some quarters as being an agricultural machinery exhibition rather than a farmers' show. From the wide variety of products exhibited it is hard to do full justice even to one or two, although the main engineering advances appear to have been in the field of tractor design.

STANDARD ATTACHMENTS

The new David Brown 2D tractor, for example, has an air-cooled twin-cylinder Diesel engine and is said to use on the average a quarter gallon of fuel an hour.* The most notable innovation in this tractor, however, was the introduction for the first time of a pneumatic system of implement control. Other new developments were exhibited covering a wide variety of equipment. A hop-picking machine introduced by Stanhay (Ashford), Limited, strips the bines without cutting them from the plant by means of an open wire drum which strips off the hops as the bines are withdrawn. The Wolseley Engineering Company, Limited, introduced the Swipe—a general-purpose "slashing" machine serviceable for pulverising potato haulms, thistles, bracken, brambles, kale stalks and other "difficult" subjects. It utilises three swinging chains for slashing and pulping the material to be destroyed. Massey-Harris-Ferguson exhibited their new Kale Cutrake which is said to be capable of cutting, loading and transporting kale in a quarter of the time the job takes when it is done by hand. Such improvements are encouraging, particularly from the point of view of the export market.

Last year this article drew attention to the variety of implements which often presented a confusing array to the farm buyer. Progress has since been made steadily in standardisation. On the question of attaching implements to tractors, two standards exist, known as Category 1 and Category 2 linkages. These enable interchangeability between tractors and equipment to be made possible in either of these two size ranges. There are standards for power take-off shaft positions and speeds, and various other points in the tractor-implement relationship. Standards have also been recently specified for agricultural discs and cultivator tines, and a standard for mowing machine parts specified in 1949 was recently revised. Committees at the British Standards Institute are considering numerous other items, and it is to be hoped that the result of their work will be speedily taken up by the manufacturing industry. Unless implement manufacturers are to lose sales rapidly to large manufacturers of "systems," something of the sort will certainly have to be done. The advantages of standard equipment in a field which embraces 300 to 400 makers of agricultural machinery are too numerous to be described extensively here, and are in any case obvious, embracing longer runs, mass production and cheaper costs and prices. Under the incentive of declining demand, 1956 may well see an even more extensive application of standardisation than has been shown hitherto.

Summing up, there can be little doubt that 1956 will present difficulties to manufacturers of agricultural machinery. In 1955 the main difficulties hampering production were strikes, shortages of materials, import cuts and licences abroad and increased farming costs in the home market. While the majority of these factors will continue into 1956, to them must be added the overall prospect of the continuing credit squeeze, intensifying competition from both competitors abroad and indigenous industries, the desire on the part of the Government to reduce the level of subsidies to agriculture, and the effect of expansion plans catching up with, and possibly surpassing, demand. The main source of income will continue to come from overseas, but it is up to machinery manufacturers to find new outlets for the products, particularly in underdeveloped countries which are in receipt of financial assistance from abroad.

* ENGINEERING issue of December 16, 1955, page 832.

PERSONAL

SIR HUGH MOLONY, BT., M.A., M.A.I., M.I.C.E., has joined the board of Stewarts and Lloyds of Ireland Ltd.

MR. PETER MASEFIELD has been elected an honorary Fellow of the American Institute of Aeronautical Sciences.

MR. J. HAROLD BROWN, chairman of Sanderson Brothers and Newbould Ltd., Newhall-road, Sheffield, has retired from the board. MR. J. A. R. BULL, managing director, has been appointed chairman and managing director.

MR. O. E. KINSEY has been elected chairman of the board of Gent & Co. Ltd., Faraday Works, Leicester, in succession to MR. A. R. LEIVERS, who has retired but retains a seat on the board.

MAJOR-GENERAL D. C. T. SWAN, C.B., C.B.E., has been elected to the board of Fred Myers Tractor and Equipment Co., and becomes managing director, in succession to MR. A. N. DIXON, who has been made vice-chairman. MR. M. R. F. LEMON has been appointed general parts manager.

MR. H. F. BEAUMONT, M.I.Mech.E., M.I.P.E., works manager, has been elected a director of the Parkinson Stove Co. Ltd., Stechford, Birmingham, 33.

MR. D. J. HAGGIE, chairman of Spear and Jackson Ltd., Aetna Works, Sheffield, retires on March 15 and will be succeeded by MR. G. F. HOWARD, joint managing director.

MR R. J. ASHLEY and MR. J. E. ATTWOOD have been elected directors of Armstrong Siddeley Motors Ltd., Coventry.

AIR VICE-MARSHAL W. A. OPIE, C.B., C.B.E., is to be principal director of aircraft research and development (Royal Air Force). AIR VICE-MARSHAL H. D. MCGREGOR, C.B., C.B.E., D.S.O., is to be assistant controller of aircraft in succession to A. V. M. Opie and AIR COMMODORE B. A. CHACKSFIELD, C.B.E. has succeeded A. V. M. McGregor as director of guided weapons (trials).

MR. WALTER WEST has been appointed deputy managing director of Leyland Motors Ltd., Leyland, Lancashire.

MR. B. SMITH, A.M.I.P.E., and MR. C. E. MIDDLEMISS, B.Com., have been elected directors of Clarkson (Engineers) Ltd., Nuneaton.

MR. A. R. MITCHELL, M.B.E., M.C., and MR. E. R. CAMERON, B.Sc., have been appointed directors of Yarrow & Co. Ltd., Scotstoun, Glasgow, W.4.

MR. C. H. FLURSCHEIM, B.A., M.I.E.E., who, since 1953 has combined the post of assistant chief electrical engineer, Metropolitan-Vickers Electrical Co. Ltd., Manchester, 17, with that of chief engineer, switchgear department, is now devoting the whole of his time to the former appointment. MR. E. NICHOLSON, M.B.E., B.Sc., A.M.I.E.E., is appointed chief engineer, switchgear department.

MR. F. M. DE BASS, B.Sc. (E.), A.M.I.C.E., A.M.I.Struct.E., has been appointed assistant (productivity and work study), Chief Civil Engineer's department, British Railways, London Midland Region.

MR. J. J. MOLINS, B.Sc., F.R.Ae.S., chief designer, Microcell Ltd., 56 Kingsway, London, W.C.2, has been made an executive director.

MR. R. W. C. REEVES has been elected chairman and MR. J. S. A. BUNTING, vice chairman of the Cable Makers Association for 1956. MR. R. A. ROBB continues for a second year as chairman of the Mains Cable Manufacturers Association. MR. H. B. DAVIES has been appointed chairman of the Mains Cable Manufacturers Association (Super Tension), and MR. N. B. FROST, chairman of the Overseas Rubber Cable Makers Association. MR. H. H. TOWNSEND has been re-elected chairman of the Rubber and Thermoplastic Cable Manufacturers Association.

MR. E. IBBOTSON has been appointed manager of the Dorman Long Britannia Constructional Works at Middlesbrough, and not at Nine Elms, London, as stated on page 38 of our issue of January 13.

The senate of Queen's University, Belfast, have conferred the honorary degree of D.Sc. upon MR. J. ECCLES, C.B.E., B.Sc., M.I.C.E., M.I.E.E., M.I.Mech.E.

MR. C. N. GOOD has retired from the sales staff of Chloride Batteries Ltd. His successor is COMDR. H. T. POWELL, R.N. (ret.), A.M.I.E.E.

★ ★ ★

COMMERCIAL

THE PLESSEY CO., LTD., Ilford, Essex, have formed an associate company, PLESSEY NUCLEONICS LTD., to handle their growing activities in the atomic field. The directors are MR. A. G. CLARK (chairman and managing), MR. E. J. EARNSHAW, MR. M. W. CLARK and DR. G. C. GAUT.

HORWITCH SMITH AND CO. LTD., have now removed their offices and works to their new modern factory at Pensnett, Staffordshire.

The London Airport telephone number of the Ministry of Transport and Civil Aviation is now SKYport 4321. Some of the air-line operators and other organisations on the Airport are now served directly from the SKYport exchange. For example, the telephone number of B.O.A.C. is SKYport 5511, and of B.E.A., SKYport 3131.

GEORGE COHEN SONS & CO. LTD., have acquired the entire share capital of DUNLOP & RANKEN LTD. MR. JOHN DUNLOP, a founder of the company in 1911, will continue to be associated with the business.

THE BRITISH ROAD FEDERATION have moved to 26 Manchester-square, London, W.1. (Telephone: WELbeck 0221.)

METALOCK (BRITAIN) LTD., 638 Grand Buildings, Trafalgar-square, W.C.2, state that their telephone numbers have been changed to WHItehall 8902–3–4–5.

An agreement has been concluded between E.M.I. ELECTRONICS LTD., Hayes, Middlesex, and INDUSTRIAL ELECTRONICS, Magnet Works, Derby-road, East Sheen, London, S.W.14, whereby E.M.I. Electronics Ltd., will act as sole selling agents, at home and overseas, for Industrial Electronics' quantity produced instruments.

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CONTRACTS

Diesel-Driven Power Plant. Orders for extensions to Pettah power station, Colombo, for a new power station at Jaffna, Ceylon, and for extensions at Cochabamba power station, Bolivia, have been secured by BRUSH EXPORT LTD., Loughborough. The Pettah contract involves 12 MW of Diesel electric plant comprising six MIRRLEES-Brush sets. The Jaffna contract calls for the supply of four Mirrlees-Brush Diesel generating sets, each developing 1,045 kW at 428 r.p.m. and generating at 11 kV. The equipment for Bolivia will consist of three NATIONAL Diesel engines each developing 1,650 b.h.p. at 333 r.p.m., coupled to Brush 1,150 kW, three-phase, 50 cycle alternators generating at 10 kV.

Locomotives. An order from the Mysore Iron and Steel Co. of India for a steam locomotive has been received by W. G. BAGNALL LTD., Stafford. It is a 2-8-2 tender engine with cylinders of 12½ in. by 18 in., the rail gauge being 2 ft. Rustenburg Platinum Mines of South Africa have also placed an order with the firm for two 0-6-0 Diesel-mechanical locomotives driven by GARDNER engines developing 200 h.p. The rail gauge is also 2 ft.

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Obituary

PROFESSOR A. O. RANKINE, O.B.E., F.R.S.

It is with regret that we record the death of Emeritus Professor Alexander Oliver Rankine, which occurred on January 20. Professor Rankine who will be remembered for his work in connection with FIDO (fog investigation dispersal operation) was born in Guildford, Surrey, in 1881. He graduated at London University in 1904, obtained the London degree of D.Sc. in 1910 and, for his work at the Admiralty experimental stations at Harwich and Dartmouth, was awarded an O.B.E. in 1919. He was Professor of Physics at Imperial College of Science and Technology, from 1919 to 1937, and chief physicist Anglo-Iranian Oil Company, Limited, from 1937 to 1947. For many years he investigated and perfected geophysical methods and applied them to the search for oil underground in Persia and elsewhere. During the war of 1939–45, Professor Rankine was released to serve the Government in various capacities and his chief work was an investigation of the conditions required for the effective dissipation of fog on airfields by the application of heat, culminating in the introduction of FIDO.

Professor Rankine was elected an F.R.S. in 1934. He was President of Section A, British Association in 1932, and of the Physical Society from 1932 until 1934 and secretary of the Royal Institution of Great Britain from 1945 until 1952.

OMNIVOROUS PRIME MOVER

A GUIDE TO FUTURE GAS-TURBINE DEVELOPMENTS

That the gas turbine is "a Proteus among heat engines" was amply confirmed by Sir Harold Roxbee Cox in the twentieth Parsons Memorial Lecture delivered at the Institution of Civil Engineers on December 13, last year. Like Proteus, the gas turbine takes many forms, adapting itself readily to different functions and operating conditions; and, like the sea god too, it enjoys a very varied diet. It is in fact this ominvorous capacity for consuming the most disparate fuels that mainly distinguishes the gas turbine from other prime movers and points the direction its future development may take. It can operate on natural gas, coal, peat, residual oils and nuclear energy and this versatility gives it a usefulness which has yet to be properly exploited. In his lecture, "The Development of the Gas Turbine," Sir Harold summarised the history of turbines both in Britain and abroad, from Hero of Alexandria to the present day, and gave an indication of current trends and prospects. From his assessment of the engine's qualities it is possible to infer the applications for which it is most likely to be adopted; and his observations and the conclusions which can be drawn from them may serve as a valuable guide to its future evolution. Some points from the lecture are given in this article.

RESIDUAL OIL AND NATURAL GAS

In discussing the gas turbine as a power-station unit, Sir Harold Roxbee Cox remarked that it had a number of advantages, actual and potential. It could quickly be brought on load, so that it was of particular value as a stand-by or peak-load set. As an open-cycle machine, it required no cooling water, so there was little restriction in siting it; it could be used in deserts and mountains where water was difficult to come by. Having no boiler, it should be more compact than a steam turbine. This advantage was to some extent offset by the need in many cases for a heat exchanger, but on the cost of housing, the gas turbine would still be preferable. The gas turbine's lower weight and size suggested a lower capital cost per kilowatt, but its demand for high-quality materials and the relatively early stage of its commercial development had so far prevented any marked advantage of this kind being demonstrated.

The other great advantage, which must admittedly still be regarded as partially potential, was the ability of the gas turbine to run on almost any fuel. The majority at present ran on oil, generally a residual oil. In the United States, however, gas turbines were used for pumping the great supplies of natural gas from Texas to the North and these ran on the natural gas itself. The need to use the indigenous fuel resources of this country economically had led in recent years to an exploration of the use of solid fuel and its derivatives in gas turbines.

HIGH LOAD FACTOR

A most notable gas-turbine installation for power production was the 40 MW Brown Boveri plant at Beznau in Switzerland which had a thermal efficiency of over 30 per cent. and comprised two units, one of 13 MW and the other 27 MW with pressure ratios of 8·8 : 1 and 8·1 : 1, respectively. Although they were not base-load plants they frequently ran with a high load factor.

In most sets good thermal efficiency was obtained by the use of heat exchangers in combination with good component efficiencies. However, a thermal efficiency of 24·5 per cent. had been achieved without a heat exchanger in the 9 MW set produced this year by the Swedish STAL company by employing a pressure ratio of 10 : 1, unusual in an industrial set.

An interesting development in France had been the application to power production of the free-piston gas turbine, and Electricité de France had also supported the interesting experiments of M. Ernest Mercier, who had developed a special form of free-piston gas turbine working in combination with a high-pressure steam generation system.

The combination of an open gas-turbine cycle with a very high-pressure gas-producer cycle was also being developed. This scheme permitted a different and perhaps still more convenient method of gas cleaning. More unexpected in character than any of these, however, was the English Electric gas turbine being installed at Stafford colliery which made use of the methane content of the ventilating air from the mine, and the Ruston and Hornsby gas turbine which ran on Scottish peat.

With all these advantages of compactness, independence of water, and omnivorousness it was perhaps a little surprising that the gas turbine had not developed more as a base-load plant. There was little doubt that the Beznau plant could run as a base-load plant so long as some blade cleaning could be done at low-load periods, but even that station was small by modern power-station standards, and no gas turbine competitive in power output with the current 100 MW and the coming 200 MW steam-turbine plants had been projected. Gas turbines of such size were certainly possible but extensive development would be needed and a considerable investment would be involved.

Marine gas turbines have been widely dealt with in earlier issues of ENGINEERING; in particular, attention has been drawn to the gas turbine installations in the Shell tanker "Auris." Another development already described was the application by the French of the free-piston gas-turbine system to marine craft; this had been carried out successfully and with special reference to minesweepers and coasters.

ROAD TRACTION AND FUEL COST

Some success, Sir Harold continued, had also been experienced in the use of gas turbines for road vehicles. These first experiments emphasised that for road work the chief problem was fuel economy. This meant, in particular, the development of suitable heat exchangers for high-compression engines. There was, however, some way to go, and for the gas turbine to compete in the field of the private car, cheapness in first cost and upkeep, dependability and economy were essential. Cheapness in upkeep was a gas-turbine characteristic; it was also a reliable machine, and cheapness in first cost was largely a matter of large production numbers; thus economy in running remained as a major problem.

Perhaps the gas-turbine car would never give the same mileage per gallon as the petrol engine, but it would be able to use cheaper fuel, possibly even residual fuel. In places where such fuel was cheap this might be a great advantage, particularly for commercial vehicles. In the commercial-vehicle field the possibilities of the free-piston gas generator combined with a gas turbine were interesting. The motor car seemed to demand both compactness and the use of a heat exchanger, and it was possible that a regenerative heat exchanger would be adopted.

LOW-DENSITY RAIL TRAFFIC

On the railways, too, the true value of the gas turbine could not be quickly assessed. Competition with steam was not a factor; steam was on the way out even in this country. The gas turbine would meet competition from two well developed and efficient rivals—electrification on high-density lines and Diesel engines on the rest. The advantages of electrification for suburban and high-density main-line traffic seemed to be so overwhelming that the true problem was to decide upon the right kind of engine for secondary routes and low-density long-distance traffic.

Technically, the gas turbine could do the job, but its adoption greatly depended on fuel costs. Where this was a less important factor than in England, as it was in the U.S.A., the gas-turbine locomotive had made an encouraging start. There were over 30 of these built or building for the Union Pacific Railroad. The Renault Company in France believed in the free-piston gas turbine. This had many of the advantages of the turbine, but with approximately the fuel economy of the conventional Diesel engine.

On the railway, the gas turbine offered high availability as it was easy to maintain; capital cost comparable with the Diesel; and good economy with cheap fuel. There was, therefore, some case for a gas-turbine locomotive in this country to run on coal. Its economy on this fuel would be much superior to that of the ordinary coal-burning steam engine. A gas-turbine locomotive of this kind, the joint production of the North British Locomotive Company and C. A. Parsons, working on the open cycle but with external combustion, would probably be running here in a few months time. This unusual choice had been made to ensure that the ash in the products of combustion did not go through the turbine. However, it was not likely to be the final method of dealing with the coal-ash problem.

A locomotive was not often called upon to give its full power. It spent the greater part of its running at about half load. The efficiency of the gas turbine at such low part loads was much reduced and this militated against high performance. To avoid this difficulty more than one gas-turbine unit could be used, probably three or four would be ideal. The first step in this direction had been taken by the Boeing Company in America; they had built a 30 ton locomotive with two small engines of 150 h.p. each.

The advantages of the gas turbine as an auxiliary were, of course, many and various, and included portability and quick starting. This particular ability was demonstrated by a gas turbine with a novel form of regenerative heat exchanger conceived by Ministry of Fuel and Power engineers and built by the English Electric Company and the Incandescent Heat Company and installed at Stafford Colliery by the National Coal Board. It was designed to use the low concentrations of methane in mine ventilator exhausts.

LOW CALORIFIC VALUE FUELS

The gas turbine generally had the capacity to run on a low calorific value fuel, and it was in consequence attractive as a means of using the energy in blast furnace gas to supercharge the blast furnace. Since the war gas turbines had been adapted to a wide variety of auxiliary duties; in small sizes they had been successful as drives for such equipment as fire pumps and naval machinery. They had also served for supercharging piston engines, pressurising boilers and for chemical process work.

Some indication of the future of the gas turbine may be drawn from the character of current research, which is mainly directed to the pursuit of economy. To this end improvements in thermal efficiency could be obtained by high pressure ratios, high aerodynamic efficiency, high combustion efficiency, high gas temperature, and high rate of heat exchange between the hot regions and the compressed air. High compression and high heat exchange were to a considerable extent interchangeable.

A continuing objective of research and development was to increase the pressure ratio of a single multi-stage axial compressor and another was to increase the contribution of each stage or row of blades. Probably the greatest dividends in performance would come from the use of higher gas temperatures. This led to two kinds of research—materials research to discover stable and practical materials, not necessarily metallic, capable of working at very high temperatures; and research on methods of cooling the turbine rotor through which the gas expanded. At the National Gas Turbine Establishment a gas turbine was running with a gas temperature of 1,140 deg. C. Each blade was cooled by air which passed from inside the turbine rotor through numerous small-diameter holes which ran radially through the blades and discharged into the main gas stream.

Of the numerous other ways that have been proposed for the cooling of turbine blades one of the most interesting was that known as "sweat cooling." The idea was to make the outer layer of the blade of a porous material so that cooling air introduced to the core of the blade diffused out over the surface. Blades of this kind made by sintering and by the coagulation of meshes were under test, but a turbine wheel employing them had not yet been run. Vibration was another problem under investigation.

REGENERATIVE HEAT EXCHANGE

The problem of the heat exchanger was largely one of compactness. Some investigators favoured the so-called regenerative type where the hot and cold fluids were passed alternately through the same passages of a matrix. It had great potential advantages, but practical difficulties had so far prevented its employment in operational gas turbines, which generally made use of the recuperative system.

Improvement in omnivorousness depended to some extent on overcoming the difficulties of using residual oils and solid fuels. Problems were of two kinds: erosion or build-up of deposits, particularly between turbine blades due to impurities in non-distillate fuels; and corrosion, also arising from impurities. Solid fuels led mostly to the first and residual oils to the latter. Cleaning of the gas was one approach and the use of additives in residual oil fuels was another. A further approach had been adopted at Beznau where it had been found possible to run for 300 hour stretches and wash the turbine with water during 20 hour stoppages.

Before these and many other investigations had taken gas turbine development much further a fresh set of problems of great complexity would be awaiting solution, the problems of the nuclear-energy gas turbine. From the thermodynamic point of view it would be the same as the familiar gas turbine, but the heat would be supplied by nuclear fission (or nuclear fusion). The source of

the new problems would be the transference of heat generated in the fuel its way into the working fluid which would have to be maintained to a great extent free of radio activity.

PRIME MOVER FOR THE ATOMIC AGE

In his lecture Sir Harold gave a very comprehensive picture of the present state of gas-turbine development, and hinted at some of the directions future progress might take. It is therefore possible to draw certain conclusions. The principal factor seems to be the gas turbine's capacity to burn a wide range of fuels and this may lead to its use in territories where orthodox fuels are not abundant or cheap. In view of the present coal shortage in this country it is unlikely that the coal-burning gas-turbine locomotive will enter into wide use at home, but it may have considerable prospects overseas where rich coal deposits remain to be mined, as in Australia. Where residual oils are plentiful, the gas turbine may prove an economic prime mover for uses ranging from power production to the propulsion of heavy road vehicles and it may serve also as a convenient means of exploiting natural gases where these are available.

But probably the most influential factor in the future of the gas turbine will be the development of nuclear power. Firstly, as more and more energy from this source becomes available, so will the need for other fuels change; thus a new balance of demand will be established, and it is conceivable that this new balance will favour the gas turbine. As oils are released from applications served by nuclear power it may be convenient to readjust the separation of oil fractions; what is more, the oils no longer required for other purposes may yield a cheap fuel for such gas-turbine applications as road or rail propulsion.

A second more direct way in which nuclear energy may influence the evolution of the gas turbine is through the development of a suitable closed-circuit turbine system for converting the heat in the reactor gases directly into mechanical power. In particular, this will call for a turbine requiring little or no maintenance, since, the hot gases will necessarily be subject to radioactive contamination and dismantling would involve long shut-down periods.

References

In the course of his lecture, Sir Harold referred to various topics and items of equipment relating to gas turbines which have recently been dealt with in ENGINEERING; references to the articles concerned are given below.

(i) *Aircraft* (vol. 180, pages 6, 356, 366, 390 and 691, 1955).
(ii) *Alloys* (vol. 180, pages 208, 328 and 405, 1955).
(iii) *Auxiliary applications* (vol. 179, pages 385, 623, 636 and 740, 1955).
(iv) *Free-piston gas generators* (vol. 177, page 686, 1954; vol. 180, pages 333 and 733, 1955).
(v) *Gas producer* (vol. 180, page 179, 1955).
(vi) *Locomotives* (vol. 172, page 793, 1951; vol. 173, pages 161 and 193, 1952; vol. 177, pages 561 and 592; vol. 178, page 351, 1954; vol. 180, page 377, 1955).
(vii) *Marine applications* (vol. 176, page 673, 1953; vol. 177, page 622, 1954; vol. 179, pages 345 and 533; vol. 180, pages 324, 333 and 859, 1955).
(viii) *Nuclear energy* (vol. 180, page 859, 1955).
(ix) *Research* (vol. 180, pages 101, 504, 538 and 566, 1955).
(x) *Residual fuels* (see *Vanadium attack*).
(xi) *Road traction* (vol. 179, page 437, 1955).
(xii) *Solid fuel firing* (vol. 180, page 239, 1955).
(xiii) *Vanadium attack* (vol. 179, page 722; vol. 180, page 49, 1955).

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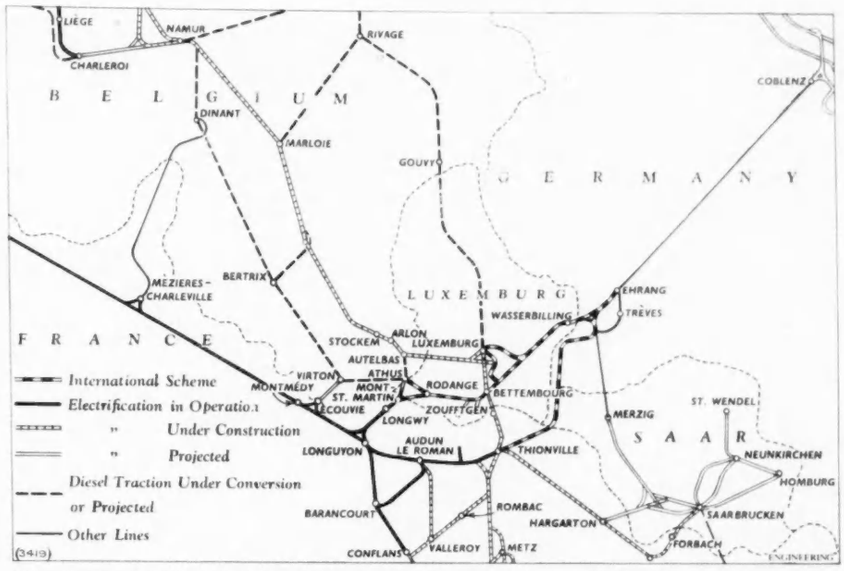
STEAM-DRIVEN AXIAL-FLOW TURBO-BLOWER

A steam-driven axial-flow turbo-blower, believed to be the first to be used in this country, provides air for the new No. 4 blast furnace at Margam Works. It was illustrated on page 68 of our issue of January 20, in an article on the furnace. We regret that in that article we did not give the name of the makers correctly. The fact is that the contract was placed with Sulzer Brothers (London) Limited, who then placed the work with Sulzer Brothers Limited, Winterthur. The latter firm built the turbo-blower and sub-contracted the steam turbine to the Oerlikon Engineering Company, Zürich.



Map showing the lines in Belgium, France, Germany, Luxemburg and the Saar which are to be electrified on the single-phase 50 cycle system to deal with the heavy coal and mineral traffic.

INTERNATIONAL RAILWAY ELECTRIFICATION

Filling an Important Gap in Europe

The *Information Bulletin* of the Centre d'Information des Chemins de Fer Européens (C.I.C.E.) contains an account of a railway electrification programme, which is interesting both from the international aspect and because it is proposed that operation shall be carried out with single phase current at industrial frequency.

The scheme which has now been adopted is shown on the accompanying map. It was prepared by a Committee which was appointed two years ago by the administrations of the Belgian, French, German, Luxemburg and Saar Railways. Starting from the extensive German sidings to the north of Trèves it involves the lines which serve the industrial areas of Lorraine and Luxemburg via Apach and Thionville in one direction and via Bettembourg and Rodange on the other. It is important as it carries the heavy traffic of the European Coal and Steel Community in an area which is intersected by five frontiers. As a result of their investigations the Committee found that the permanent way and motive power and rolling stock were fully capable of meeting requirements and could in fact deal with a large increase in traffic.

INTENSIVE COAL TRAFFIC

A study of the schemes of electrification or "Dieselisation" under construction or projected in the area, showed a gap in one of the most important of the groups studied: the main Moselle line from Coblenz to Thionville via Ehrang and the branch from Ehrang to Bettembourg, Rodange, Mont St. Martin and Athens. No scheme for modernising these lines was under consideration, in spite of the fact that they carry the major part of the solid fuel traffic from the Ruhr and the Aix-la-Chapelle area to the French and Luxemburg steel works.

The reason for this is undoubtedly that these lines cross several frontiers and come under a number of railway administrations. The Committee, therefore, consider that to obtain more flexible and rational operation the lines in the Mont St. Martin-Bettembourg-Ehrang triangle and from Ehrang to Thionville, which represent the international part of the artery in question, should be converted to electric traction. The electrification of the Ehrang-Coblenz section, which will allow a junction to be made with the lines in the Rhineland (now being electrified) is also to be studied as part of the German modernisation programme.

As already mentioned, a single-phase system at 25 kV and a frequency of 50 is to be adopted for operating purposes. It will therefore be possible to obtain good utilisation of the locomotives, which will be able to serve the whole of the Lorraine industrial area. The Saar Railways will also be operated on the same system. As the length of electrified lines in German territory will only be 42 miles out of a total of 115 miles the Committee did not consider it desirable for Germany to build up a fleet of 50 cycle locomotives. Operation on the German lines as far as Ehrang will therefore be carried out by French and Luxemburg locomotives, which will be designed so that inter-running is possible. A connection with the 3,000 volt direct-current system of the Belgian Railways will be made in Luxemburg station. It will not be necessary to alter the make-up of the trains owing to the change from electric to steam traction that will have to be made at Ehrang.

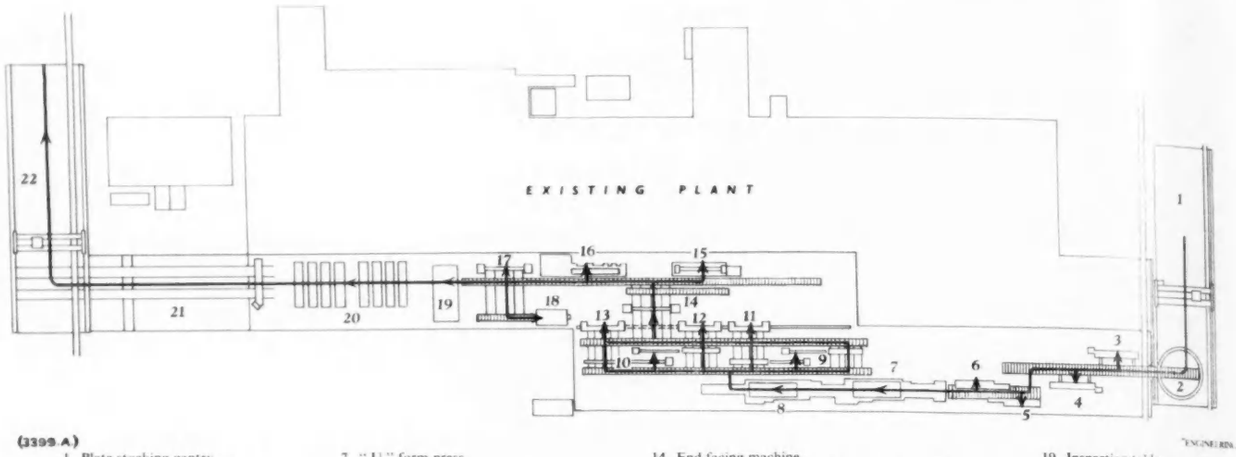
Power for operation will be obtained from the industrial network through substations at Luxemburg and Thionville, with possibly a third at Ehrang.

In commenting on this electrification programme the *Information Bulletin* points out that it forms a unique example of international co-operation in railway matters. Extending over an area where the course of the frontiers is particularly complicated, it should permit a great improvement in transport conditions. This improvement would be the more marked if Customs restrictions, which weigh heavily on the international steel and coal traffic, were modified.

PROGRESS IN HOLLAND

Information is also given upon the progress of electric traction in Holland. At the moment 838 miles out of a total of 1,920 miles are worked in this way, but the electrification of the lines from Eindhoven to Venlo and from Gouda to Alphen-aan-de Rijn will be completed in June, those from Roosendaal to Breda and from Tilburg to Nijmegen in June, 1957, and that from Alkmaar to Den Helder in January, 1958. In 1958, therefore, the length of electrified lines in Holland will be over 1,000 miles or more than half the total network.

In June, 1957, too, the electrification of the frontier line from Roosendaal to Antwerp will be completed, thus allowing electric trains to be run through from Amsterdam to Brussels.



(3399 A) "ENGINEERING"

1. Plate stocking gantry.
2. Inward delivery turntable.
3 and 4. Edge planing machines.
5 and 6. Edge setting machines.
7. "U" form press.
8. "O" form press.
9 and 10. Internal welding machines.
11, 12 and 13. External welding machines.
14. End facing machine.
15 and 16. Hydraulic expanding and testing machines.
17. End bevelling machine.
18. X-ray room.
19. Inspection table.
20. De-scaling plant.
21. Transfer bay.
22. Outgoing stockyard.

Fig. 1 The South Durham Steel and Iron Company's new pipe plant at Stockton-on-Tees is laid out for flow production of welded steel pipes from 16 in. to 40 in. in diameter, up to 40 ft. long and in plate thicknesses from ¼ in. to ⅝ in.

PRODUCTION OF LARGE-DIAMETER WELDED STEEL PIPES

NEW PLANT AT STOCKTON-ON-TEES

The South Durham Steel and Iron Company, Limited, first installed plant for the production of large-diameter welded steel pipes at their Malleable Works, Stockton-on-Tees, in 1926. For a number of years the welding was carried out by the water-gas process, but in 1950 the automatic submerged-arc process was introduced, and this method of welding has now superseded the older one. Many large contracts, for home and overseas, have been executed in the Stockton plant. The extension of pipe-line laying in various parts of the world and the revised specifications now in force for steel pipe led the company in 1954 to decide on the erection of new, self-contained plant for the production of pipes on a large scale. This plant, which came into commercial production in the middle of 1955, and was officially opened by the President of the Board of Trade, the Rt. Hon. G. E. P. Thorneycroft, M.P., on November 25, is now completed, and is claimed to be the most modern of its kind in Europe.

The Stockton plant is laid out and equipped for flow production in large quantities of welded steel pipes from 16 in. to 40 in. in diameter, in lengths of up to 40 ft., and plate thicknesses from ¼ in. to ⅝ in. The quality of the pipes produced is very high, and meets in every particular the requirements of the oil companies and of the American Petroleum Institute. The general layout of the plant is shown diagrammatically in Fig. 1.

PLATE-EDGE PREPARATION

All the steel plate used in the plant is rolled at the South Durham Steel and Iron Company's West Hartlepool Works, a few miles to the north-east; transport to Stockton is principally by rail, but road vehicles can also be unloaded if necessary. On arrival at Stockton the plates pass to a stock gantry, which has an overhead electric travelling magnet crane of 15 tons capacity. This lifts the plates from the transport vehicles and deposits them on a motorised roller conveyor track mounted on a turntable. This turntable is also motorised, and it swings the plates through an angle of 90 deg. to bring them in line with the end of the roller conveyor leading into the first bay of the pipe plant. This bay, which is 716 ft. long and 80 ft. span, was, like the other buildings and structural work in the plant, designed, fabricated and erected by the company's structural department, which occupies an adjacent site. Two 15 ton overhead electric travelling cranes are installed in the bay for general lifting services.

Immediately on entering the first bay the plates pass through a low-temperature gas furnace which gives a small degree of pre-heat, but is principally intended to dry off any moisture which the plates may have picked up during transit.

Edge-planing of the plates follows, two identical 40 ft. edge planers made by Crosthwaite Furnaces and Scriven Machine Tools, Limited, being provided for this purpose. One of these machines is shown in Fig. 2. The planers are set on opposite sides of the roller conveyor track, and are staggered, so that plates can move in a straight line from the planing of the first edge to the planing of the second. Both machines are provided with three magnet trolleys running on rails from beneath the roller conveyor to the planing position. These trolleys are run out under the control of the planer operator, the magnets are energised when the trolleys are under a plate or stack of plates on the conveyor, and the trolleys are then reversed to draw the

Fig. 2 The first operation is planing of the plate edges, which is done on two Scriven edge-planers.

Fig. 3 Both edges are then formed to a radius in special presses of the company's own design.

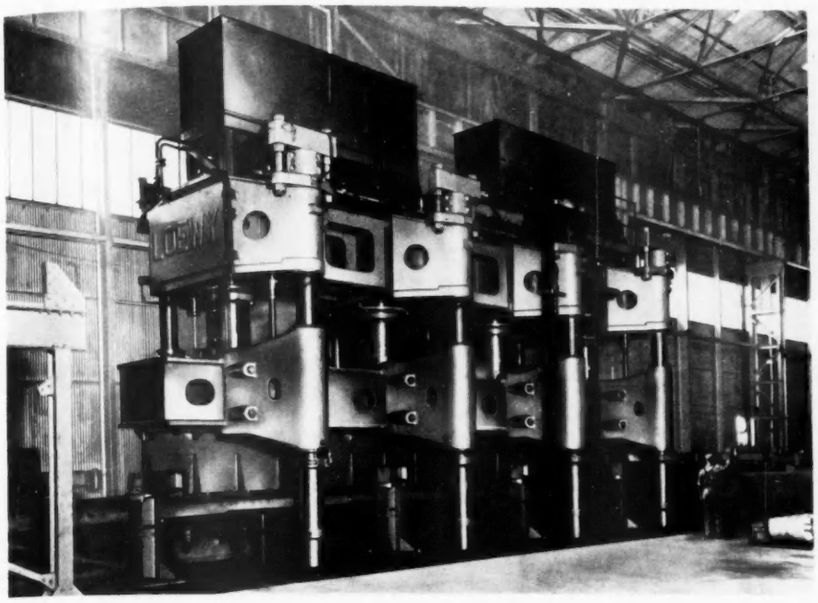


Fig. 4 The prepared plates pass next to a 3,600 ton hydraulic press where, in a single pressing operation, each plate is pressed to " U " form, as shown in Fig. 5.

plates across a series of castor-mounted rollers to the planing position. By moving the trolleys individually the operator can align the plates as required.

The planers will deal with plates in stacks up to 2 in. thick at speeds of up to 60 ft. per minute. A slight bevel is planed on each edge of every plate; this, when the plate is bent into shape ready for welding, forms a small groove which guides the head of the welding machine as the inside weld is made.

FORMING IN THREE STAGES

When the edges of the plates have been planed they pass, singly, to two identical edge-setting machines each of 1,500 tons capacity, which, like the planers, are installed in tandem so that the movement of the plate from one machine to the other is in a straight line. The machines were designed and built by the South Durham Company to perform the initial edge-setting or radius-forming on the extreme edges of the plates. They are of heavy fabricated steel construction with a stationary top beam carrying the top tool, and a moving lower beam to which the bottom tool is attached (Fig. 3). An inclined hydraulic cylinder and piston, taking water at 1,500 lb. per square inch from the works mains, pushes a set of wedges mounted in a horizontal plane and raises the lower beam which rests on them, so forming the required radius on the edge of the plate. A small-span overhead electric travelling crane and gantry are provided to handle the plates at and between the two edge-setting machines.

Plates which have been set to the required radius on both edges pass next to a hydraulic press where they are pressed into " U " form. This press (Figs. 4 and 5), which was designed and built by the Loewy Engineering Company, Limited, has numerous fabricated steel components made by the South Durham Company. It is of 3,600 tons maximum capacity, with self-contained hydraulic equipment working at up to 4,500 lb. per square inch, and forms the prepared plate into the shape of a letter " U " in a single pressing operation. Interchangeable dies are provided to accommodate all sizes of pipe in the range produced. Having received its " U " form the plate, now known, according to local custom, as a " skelp," is lifted from the bottom die by a number of hydraulic pistons with rollers mounted on them, and is removed from the press by a chain conveyor.

Immediately following the " U " press is a second press, also of Loewy manufacture. This is the " O " press (Figs. 6 and 7), where the skelp is formed, in a single pressing operation, into a complete circle, with the edges closely butted ready for welding. The " O " press, like the one immediately preceding it in line, incorporates several South Durham fabrications, and is also self-contained, with a hydraulic system operating at up to 4,500 lb. per square inch. It exerts a maximum load of 16,000 tons. Interchangeable dies enable the press to deal with any pipe within the stated range. A chain conveyor similar to, and interlocked with, that on the " U " press, removes the formed skelp from the " O " press on to a line of motorised rollers, which transfer it to the next operation, tack-welding.

INTERNAL AND EXTERNAL WELDING BY MACHINE

Short pieces of steel plate are hand-welded on to the skelp at the ends of the longitudinal butt-joint, ready for the automatic welding machines; the pieces of plate form a " run-on " and " run-off " for the welding heads. Hand welding is also used to tack-weld the joint at intervals on the outside.

From tack-welding the skelp is transferred over motorised rollers and skid-tracks to one of four inside welding machines. These machines each employ a specially-adapted Lincoln submerged-arc welding head, which is held on a cantilever arm while the skelp is traversed against the stationary head at the correct welding speed. The head is guided over the weld by the groove formed by the bevel-machining of the plate edges. Traversing is by means of a wheeled carriage on which the skelp rests, the motion being provided by a motor-driven screw and a change-speed gearbox. This allows for different welding speeds as required, and also gives a high-speed return of the carriage when the weld is complete. An air-blast fixed ahead of the welding head clears away any loose dust which may be present, and flux is spread from a hopper on the head in the normal manner. Unfused flux is recovered for re-use by means of a vacuum unit. The internal welding machines were designed and built by the South Durham Company in co-operation with the Lincoln Electric Company, Limited.

At the conclusion of the internal welding operation the product, now no longer a skelp but a partly-finished pipe, passes to the second bay of the pipe plant. This bay is 740 ft. long

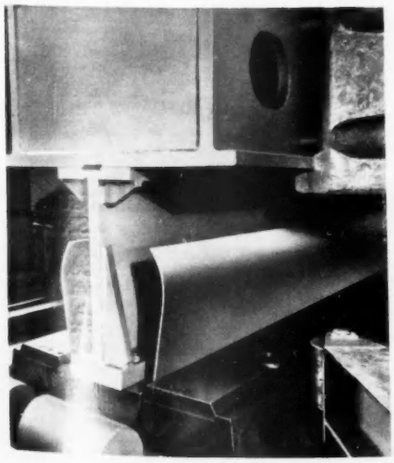


Fig. 5 [I]nterchangeable dies on the " U " press enable it [to] deal with any size of plate within the range handled.

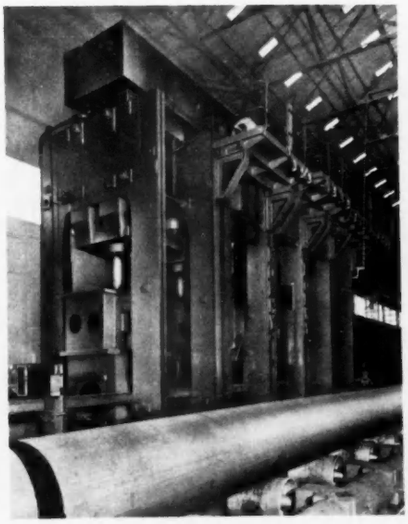


Fig. 6 A similar but larger unit, the " O " press, takes the " U " form and presses it, in one operation, to a complete circle.

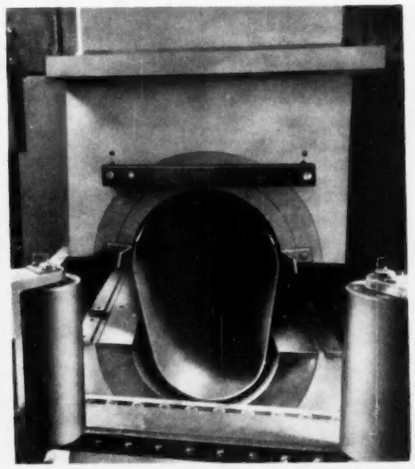


Fig. 7 On the " O " press also, the dies are interchangeable, to suit the whole range of pipes being produced.

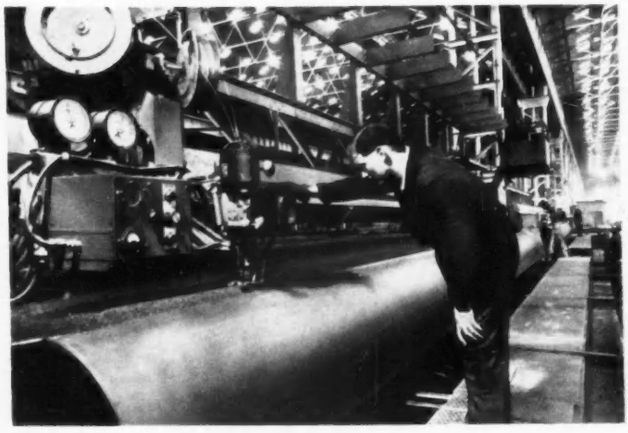


Fig. 8 After pressing to circular form the pipes are welded on automatic submerged-arc machines. Inside welding is done on single-arc machines and outside welding, shown here, on twin-arc machines.

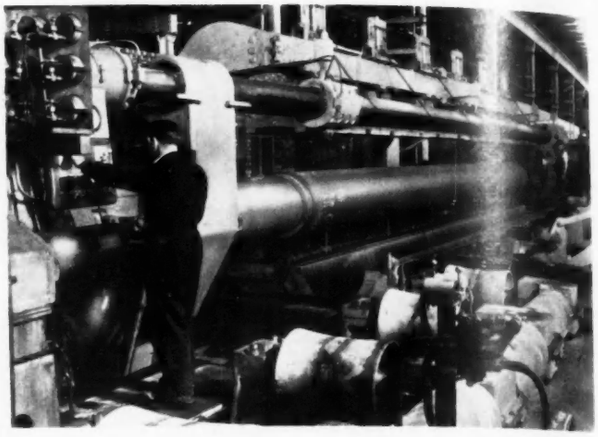


Fig. 9 Welded pipes are faced square at each end and then expanded hydraulically inside dies in a specially-designed machine. In this illustration the dies are shown open and the pipe is in position.

and 80 ft. span, and like the first bay, is served by two 15 ton overhead electric travelling cranes.

In moving from one bay to the other the pipes pass through one of three external welding machines, which are also based on Lincoln submerged-arc welding heads, but in this case the heads are of the twin-arc type (Fig. 8). Faster welding speeds being possible in the case of the external welding machines only three are needed to handle the output from four inside machines. As in the previous welding operation, unfused flux is collected by a vacuum unit. The covering of fused flux on the welds is then removed, and the complete weld, both inside and outside, is examined closely by an inspector before the pipes are allowed to proceed to the next operation.

HYDRAULIC SIZING AND TESTING

The first operation in the second bay is end-facing, the two ends of the pipe being machined simultaneously on a double-headed Broadbent machine. The internal welds are then ground flush at each end of the pipe for a depth of 4 in., and the pipe passes on to the hydraulic expanding and testing machine.

This machine (Figs. 9 and 10), which is of Loewy design and manufacture, operates on an automatic cycle. It consists of two heads carrying plungers on which the pipe is located, a set of dies which are hydraulically operated, an electrically-operated loading and unloading carriage, and self-contained oil and water hydraulic systems; oil is used for the operation of the dies and control gear, and water under hydraulic pressure is used for expanding and testing the pipes.

A pipe approaches the machine on motorised rollers and comes to rest against a stop. The loading carriage then traverses sideways and lifts the pipe by means of arms passing beneath it and between the rollers, and holds it in line with the two plungers. These then move axially in relation to the pipe, so entering the ends. The loader then retracts. Near the extremity of each plunger is an annular " U " seal, which is loaded hydraulically as soon as the pipe is in position, so sealing the ends against the hydraulic pressure which is about to be applied to the inside of the pipe. Water now enters the pipe through the left-hand or " control-end " plunger; this water is for prefilling only. It is at low pressure, and is supplied by centrifugal pumps drawing from the machine sump.

Meanwhile, the dies or " mantles " are being closed hydraulically. The dies are split into halves, pivoted at the bottom, and pushed up by hydraulic cylinders after the pipe has been located on the two plungers. As soon as the tops of the dies meet, a locking clamp is lowered to hold them in the closed position. The pipe being filled and the dies closed, the hydraulic pressure is raised until the pipe is expanded into the dies, ensuring that the outside diameter is correct, and that the yield point is raised in accordance with the specification. As the pipe expands it is reduced in length slightly, and the two plunger-carrying heads move inwards to compensate for this shortening.

The hydraulic pressure is now reduced, the dies open, and the pressure is raised again, this time to the figure specified for test purposes. While it is under this pressure the weld is examined carefully. The pressure is then taken off completely, and the water is allowed to drain into the machine sump, where it is available for re-use. Make-up water is drawn from the town mains as required. Finally, the loading carriage is used to remove the pipe from the machine to the motorised rollers by which it is taken to the next operation. A second expander is installed nearby as a reserve machine.

A double-headed Broadbent machine, similar to that used for end-facing, is next in line to the expander. Here the ends of each pipe are finally faced and bevelled ready for welding together on site.

The line then leads to a final inspection bench, where every pipe is subjected to a detailed inspection by the company's own inspectors, supplemented, as occasion demands, by customers' representatives. Provision is made at this point for the pipe to be taken off the line to an adjacent X-ray room, which is equipped with two units each of 250 kVA capacity.

After final inspection the pipes pass to a transfer bay and finally to a stockyard, which can deal with both road and rail vehicles.

If required, the pipes can be hot sulphuric-acid pickled and phosphate coated before they leave the end of the second bay.

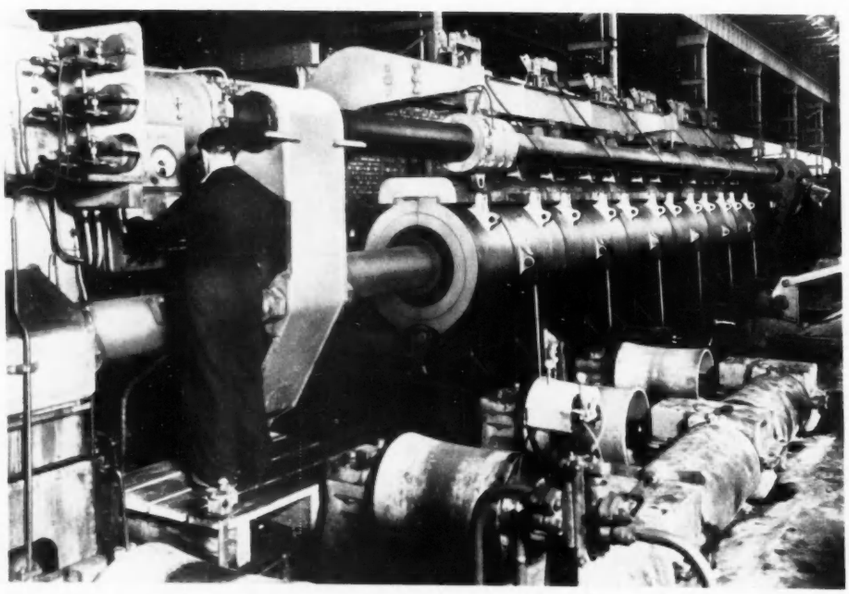


Fig. 10 With the dies closed hydraulically and locked, as shown here, the full pressure is applied inside the pipe, which expands it to the correct diameter and raises the yield point.

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STRUCTURAL ALUMINIUM RESEARCH SCHOLARSHIP

The Institution of Structural Engineers accepted, in 1954, an offer by the Aluminium Development Association of a research scholarship to the value of £400 a year to enable the holder to undertake research on some aspect of the application of aluminium alloys to structures. The scholarship is awarded in alternate years for a two-year period. It is the intention to make the next award of this scholarship in 1956 with a view to the successful applicant commencing his investigations at the beginning of the university session in October next. Particulars can be obtained from the secretary, Institution of Structural Engineers, 11, Upper Belgrave-street, London, S.W.1.

DEFINING CONCRETE MIXES*

RECOMMENDED DATA FOR INCLUSION IN REPORTS

In comparing a concrete described in one published report with that described in another, difficulties are often experienced owing to the absence in either or both reports of certain of the relevant data. This is especially so in comparing concretes for dams, partly owing to the complexity introduced by their special characteristics, e.g., the use of aggregates of large maximum size, the use of lean mixes, etc., and partly owing to the number of aspects from which comparisons may eventually be required, e.g., strength, permeability, heat evolution, frost resistance. In order to assist those compiling reports on concretes for dams in deciding what data to include and in order to encourage the presentation of data likely to be of use in future researches, the International Sub-Committee on Concrete for Large Dams has prepared lists of the minimum data which it recommends should be included in future published reports. No finality, of course, can be claimed for such lists; their extension must depend on future developments in concrete technology.

While it is obviously desirable that a full report should be published on the concrete used in each dam it is recognised that on occasions only a brief description of the concrete can be included. It is recommended that each type of report should include the following minimum data.

MINIMUM DATA REQUIRED

a. Cement content of finished concrete (in kg. per cubic metre or lb. per cubic yard).
b. Effective water/cement ratio (i.e., corrected for aggregate in the saturated, surface-dry condition).
c. Type or types of cement, with reference to any standard specifications applicable. (In the case of " blended " cements, the proportion by weight of pozzolana or other material present should be stated.)
d. Broad petrological classification of aggregate, e.g., limestone, granite, etc., origin (i.e., crushed or natural), and maximum size employed.
e. Method of compaction.
f. Use of a workability aid or air-entraining agent.
g. Estimated air content of finished concrete, whether entrained or entrapped, as a percentage by volume.

In the event of it being possible to publish a full report, the following are recommended for inclusion.

FULL DATA

Cement

a. Type or types of cement, with reference to any standard specifications applicable. (In the case of " blended " cements, the proportion by weight of pozzolana or other material present should be stated.)
b. Specific gravity of cement; e.g., as determined in distilled kerosine.
c. Chemical composition of cement, including percentage of alkalies present.
d. Properties of cement, including strength, fineness and heat of hydration. (The method of test should be briefly indicated with reference to any standard specification applicable.)

Admixtures (including workability aids, air-entraining agents, etc).
a. Nature of added material.
b. Amount of added material (usually in terms of a unit weight of cement).

Properties of aggregate (including sand or inert additions).

The following data are required on the aggregate where a concrete mix contains material from more than one source (e.g., where a natural sand from a pit or river deposit is used in conjunction with crushed rock from a quarry) the data should be given separately for each source of material, irrespective of any overlap in particle sizes.
a. Petrological type and description, origin (i.e., crushed or natural), particle shape, and surface texture.
b. Size distribution and proportion by weight of the total aggregate in the mix.
c. Absorption of water by weight from the oven-dry (100 deg. to 110 deg. C.) condition to the saturated, surface-dry condition.
d. Coefficient of thermal expansion of aggregate material (more especially for concretes exposed to frost action).

Combined aggregate (as used in the concrete mix)
a. Maximum size of aggregate used.
b. Complete grading analysis of the combined aggregate expressed in terms of " dry " weights (see next note, *c*). (The grading analysis should cover aggregate sizes down to the finest sand; it should include a statement of the percentage by " dry " weight of fine material passing the A.S.T.M. No. 4, or equivalent, sieve).
c. Absorption of water by weight, from the " dry " condition (i.e., as used in the grading analysis) to the saturated, surface-dry condition, of the fractions above and below the A.S.T.M. No. 4, or equivalent, sieve. (The " dry " condition used for grading may differ between countries and may range from the oven-dry to the saturated, surface-dry condition. The data on absorption are necessary in order that the mix may eventually be expressible in terms of the absolute volumes occupied in the finished concrete.)
d. Specific gravities in the saturated, surface-dry condition of the fractions above and below the A.S.T.M. No. 4, or equivalent, sieve.
e. Method of batching (i.e., by weight or volume); size limits of the aggregate fractions which are batched separately.

Concrete proportions

In the concrete mix:—
a. Aggregate/cement ratio by weight, stating whether the ratio is based on aggregate in the " dry " condition (see " Combined Aggregate " above) or has already been corrected for the saturated, surface-dry condition using the data already given. (The proportion of aggregate passing the A.S.T.M. No. 4, or equivalent, sieve will already have been given above.)
b. Effective water/cement ratio by weight (i.e., corrected for aggregate in the saturated, surface-dry condition).
In the finished concrete (i.e., in the concrete in place in the dam after compaction but before any water loss through drying):—
c. Estimated cement content of the finished concrete (in kg. per cubic metre or lb. per cubic yard).
d. Estimated air content of finished concrete, whether entrained or entrapped, as a percentage by volume.
e. Estimated density of finished concrete.

(These three estimated quantities are interrelated and will, in many cases, be based on the measured volume of the finished concrete as compared with the amount of cement used. They should be consistent both with each other and with the data already given on the mix proportions by weight and by absolute volume.)

Workability and method of compaction

(*Editor's Note:*—No details specified in report.)

Properties of concrete and quality control

a. Dimensions, preparation and curing of control cubes, prisms, or cylinders.
b. Statistical variation in strength or of other properties measured. (This should include the number of specimens tested, the average strength or other property measured and the coefficient of variation.)
c. Method of removing the large aggregate from the concrete used for test specimens when aggregate above a certain size is excluded.
d. Measured air content of mix; e.g., as measured on a sample of fresh concrete in an air meter.
e. Measured density of mix; e.g., as measured on a concrete specimen.

GENERAL NOTE

Care should be taken that sufficient of these data are included to permit calculation of the composition, in terms of the absolute volumes occupied in the finished concrete by the cement, aggregates, water and air, of both :—
(*a*) the total concrete, and
(*b*) that part of the concrete material below the A.S.T.M. No. 4, or equivalent, sieve size (i.e., excluding the larger aggregate). (Inclusion of the data under this heading (*b*) provides for the possibility of comparing different concretes containing large-size aggregates through the properties of their matrix mortars.)

Where the composition of the concrete by absolute volume has been calculated it should be given in addition to the more conventional mix data.

* " Recommendations of the International Sub-Committee on Concrete for Large Dams on the Definition of Concrete Mixes used in Dam Construction." Paper No. 11 of Report submitted by the Committee to the Fifth Congress on Large Dams, Paris, 1955. Reference to the Report will be made in " Books received," in a subsequent issue.

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MOND NICKEL FELLOWSHIPS

Applications for the award of Mond Nickel Fellowships for 1956 are now invited by the Mond Nickel Fellowships Committee. The main object of these fellowships is to enable selected applicants of British nationality and educated to university degree or equivalent standard to obtain additional training and wider experience, so that, employed as executives in the British metallurgical industries, they will be better qualified to appreciate the technological significance of research and to apply its results. There are no age limits, though awards will seldom be made to persons over 35 years of age. Each fellowship will occupy one full working year. It is hoped to award five fellowships each year of an approximate value of £900 to £1,200 each. Applicants will be required to define the programme of training in respect of which they are applying for an award, as well as particulars of their education, qualifications and previous career. Full particulars and forms of application can be obtained from the secretary, Mond Nickel Fellowships Committee, 4 Grosvenor-gardens, London, S.W.1. Completed application forms must reach the secretary of the committee not later than June 1, 1956.

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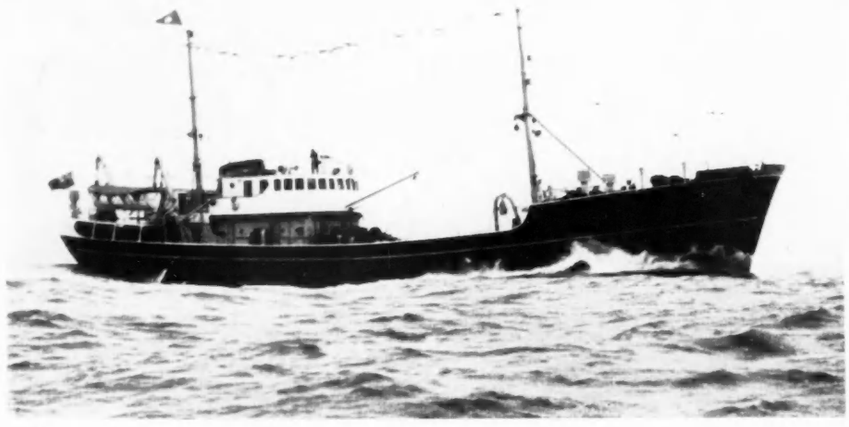
HUMBER PORTS

B.T.C. authorise expenditure of £2,500,0000

The British Transport Commission have announced details of the improvement works, involving a total expenditure of over £2,500,000, which have been authorised for the Humber ports. At Hull, the principal scheme will involve the expenditure of £1,500,000 on the provision of a riverside quay, and on reconstruction of the south side of Albert Dock, to replace facilities destroyed by enemy action during the last war. These works will comprise construction of the new quays, together with transit sheds, passenger accommodation and offices, and the installation of the necessary cranage.

Sir Bruce White, Wolfe, Barry and Partners have been appointed consulting engineers for the project which, it is hoped, will be completed early in 1958.

A number of schemes for the improvement of the other Humber ports have also been approved by the Commission, involving expenditure of the order of £500,000. These include extensive reconstruction of some quays and jetties, resurfacing of roads and renewal of some railway sidings.



British built Diesel-engined trawler " Pioner " for service in the Arctic.

DIESEL-DRIVEN TRAWLERS FOR RUSSIA

On January 13, after a successful trial in the North Sea, the Diesel-driven trawler Pioner was handed over by Brooke Marine, Limited, Lowestoft, to the U.S.S.R. Authorities in the presence of Mr. V. A. Kamensky, the head of the Russian Trade Delegation in this country. She is the first of 20 similar craft ordered from Brooke Marine, Limited, for service in the Arctic and is specially equipped to operate in far Northern waters and for navigation in ice.

The principal dimensions of the Pioner are as follows: length overall, 189 ft. 9 in., and between perpendiculars, 171 ft. 9 in.; breadth moulded, 32 ft.; depth moulded, 16 ft. The vessel is flush-decked and is subdivided by four watertight and two oil-tight bulkheads. The two fish holds have a combined capacity of 420 cub. m. and there is also a hold for fish meal, with a capacity of 50 cub. m.; in all, these holds can stow 365 tons of fish and meal. Accommodation is also provided for 10 tons of canned livers and 20 tons of liver oil. Fuel oil for the main Diesel engine and for the auxiliary boiler is carried in 'thwart-ship tanks immediately forward of the engine room, and between these tanks and the fish holds is the plant for producing fish meal, liver-oil tanks, and, in the wings, stowage for the fish meal. The crew's quarters are forward of the fish holds and the officers' quarters (other than the cabins for the captain and the chief engineer, which are in the bridge house) are abaft the engine room. Domestic fresh water and boiler feed water are carried in double-bottom tanks beneath the fish holds and the trawl store, and other double-bottom tanks, beneath the deep tanks and the fish-meal compartment, are available for the stowage of additional Diesel oil. The total quantity of Diesel and lubricating oil that can be carried is 95 tons and of boiler oil, 40 tons. The normal fresh water capacity is 53 tons, but additional fresh water can be carried in the fore peak tank if required.

The fish holds, of the type developed by Brooke Marine, Limited, are insulated with plastic X.1003 slabs supplied by the Expanded Rubber Company, Limited, and fitted by the Miller Insulating and Engineering Company, Limited. They are lined with aluminium alloy sheeting down to the tank top and are divided into " pounds " by corrugated aluminium boards fitted into slotted aluminium posts; these boards are of uniform size and shape, and are interchangeable throughout the holds in which they are used. At the sides of the ship, the holds are lined with permanent aluminium sheeting. The floors of the holds are also insulated and are covered with cement. They slope inwards to a central gutter leading to slush wells at the after end of each hold.

There are four trawling gallows, two forward and two aft, served by an electric trawl winch constructed by J. Robertson and Sons, Limited, the motor developing 175 h.p. at 600 r.p.m.; the electrical equipment was supplied by Laurence Scott and Electromotors, Limited. The winch has two barrels, each capable of holding 1,200 fathoms of 3 in. wire rope, and can exert a pull of 8 tons at a speed of 60 m. per minute. The winch motor is separately mounted in the forward end of the deckhouse, immediately behind the winch, and is controlled through Ward-Leonard gear in the engine room.

Current for the trawl winch is supplied by a differentially compound-wound generator with an output of 146 kW, directly coupled to a Mirrlees JS4 Diesel engine which develops 380 b.h.p. at 750 r.p.m. The shaft of this generator is extended to couple with an auxiliary generator, of 53 kW capacity, 3 kW of this output being used for excitation current and the remaining 50 kW being supplied to the main switchboard. There is also a second generator, of 50 kW capacity, driven through a flexible coupling by a McLaren M.4 Diesel engine, developing 88 b.h.p. at 1,000 r.p.m.; and an auxiliary general-purpose set comprising an 18 kW generator driven by a McLaren M.2 Diesel engine of 44 b.h.p. at 1,000 r.p.m. This 18 kW set has an extended shaft which drives, through a friction clutch, an air compressor which will deliver 28 cub. ft. per minute.

The main propelling engine is a Mirrlees type KSSDM eight-cylinder single-acting unit, operating on the four-stroke cycle and employing solid injection and turbo-charging. It is directly reversible and has a power output of 950 to 1,100 s.h.p. at 255 to 265 r.p.m. Lubrication is on the dry-sump principle, the lubricating oil being supplied under pressure to all the moving parts by two engine-driven pumps. There is also a Hamworthy standby lubricating-oil pump, electrically driven. The fresh-water circulating pump is driven from the main engine and draws from the line to the cylinder jackets, discharging through a heat exchanger cooled by sea water. The pump which circulates the sea water to the heat exchanger is also engine-dr[illegible]n and has a by-pass to the main engine jacket[illegible]r emergency cooling. A Drysdale standby [illegible]ater pump, electrically driven, can be use[illegible]lso to serve the main engine fresh and salt [illegible]ater systems, and is cross-connected to the wa[illegible]-deck service and the fire main.

Steam is used for heating the fishmeal dryers and processing the raw fish, for sterilising the cans to contain fish livers, for freeing the decks and the ship's-side discharge valves from ice and, of course, for washing purposes in the officers' and crew's accommodation. It is provided by an oil-fired Cochran boiler with an evaporation of 1,000 kilograms of water per hour and a Clarkson thimble-tube boiler, which can evaporate 200 kilogrammes per hour and can be heated either by exhaust gases from the main engine or by an oil burner. There is a steam distiller-evaporator with an output of 5 tons a day.

Special attention has been given to the warming of the cabins and other accommodation, in view of the latitudes in which the vessel will operate. All external walls and the bulkheads adjacent to cold spaces have been insulated, and hot air heating is provided which will maintain an internal temperature of 18 deg. C. with outside temperatures as low as — 30 deg. C. The contractors for the ventilation and heating system are R. B. Stirling and Company, Limited, and for the insulation, the Darlington Insulation Company, Limited.

Fish handling equipment and other auxiliary machinery, not previously mentioned, includes a Freon refrigerating compressor, supplied by L. Sterne and Company, Limited; fishmeal plant, supplied by the Farrar Boiler Works, Limited, which can handle a ton of raw fish at a time; a screw-type Mono pump, with a capacity of 72 cub. ft. per hour, which pumps fish livers through a 4 in. pipeline to the liver processing plant; a liver canning plant supplied by the Premier Filter Press Company, Limited; a ventilating plant for the engine room which is designed to provide 25 changes of air per hour; and a well-equipped workshop on the port side of the engine casing. The main switchboard was supplied by Erskine Heap and Company, Limited, and the electrical installation throughout the ship by the Lowestoft Electric Company, Limited.

Navigating equipment includes an electrically driven windlass by Clarke, Chapman and Company, Limited, which can lift simultaneously the two Hall's stockless bower anchors from a depth of 80 metres at a speed of 9 metres per minute. The chain locker contains 300 metres of 1⅛ in. stud-link cable, secured on deck by Wardill bow stoppers. The Redifon wireless equipment comprises main and emergency transmitters and receiver, and a rotating loop direction finder. Other items of equipment include a Pye marine sound reproduction installation with radio receiver and record player, a Bendix echo sounder, a Chernikeef log, a Revometer revolution indicator, a searchlight, loud hailer, and standard and steering compasses. The compasses were supplied by Henry Browne and Sons, Limited. The telephone system was installed by the Telephone Manufacturing Company, Limited.

The rudder is of the semi-balanced streamlined type and is controlled by a Donkin electro-hydraulic steering gear, with a changeover cock on the bridge for changing from power to hand operation. The Fleming lifeboats are of aluminium alloy and are carried in Schat davits. Aluminium alloy has been used extensively in the construction of the superstructure, and also for the funnel, and was supplied by the T.I. Aluminium Company, Limited.

The hull, rudder, shafting and propeller have been specially strengthened for navigation in ice, and, in calculating the stability, icing conditions have received particular attention, an allowance of 22 tons being made for the weight of accumulated ice, with additions for wet nets and heeling moments due to wind pressure. At the worst, it is calculated, the limit of positive statical stability will not be less than 60 deg.

In Parliament

STEEL PRODUCTION

Questions covering many aspects of the national life and well-being awaited Ministers at the reassembly of Parliament on January 24, at the termination of the Christmas recess. In the House of Commons, Mr. Austen Albu (Labour) inquired about plans for meeting the nation's requirements of steel, particularly of plates and sheets, during the next five years. He said that Britain had imported steel worth £88 million in 1955 and, having regard to the growth of the engineering industry and to the orders which had been received by the shipbuilding industry, demands for steel would rise still further. For these reasons, he felt that the President of the Board of Trade had a certain responsibility for the steel industry's expansion plan. He also asked if the rumours that private firms were unwilling to take the risk of this expansion were true.

Mr. Peter Thorneycroft, President of the Board of Trade, said he did not think there was any truth in these rumours, but that Mr. Albu was quite right to draw attention to the importance of the expansion plan. It was under close consideration by the Iron and Steel Board, whose first responsibility it was. Mr. Thorneycroft said he had been advised by the Board that steel production was expected to increase over the three-year period 1956 to 1958 by more than three million ingot tons. Within that overall figure, there would be substantial increases in the capacity for sheet production and, towards the end of the period, some increases in the capacity for plate production.

Steel for Cranes

Shortages of steel confronting the crane-making industry were referred to by Lady Tweedsmuir (Conservative), who inquired whether the large amount of unfabricated steel now being exported might be curtailed. She also asked if the President of the Board of Trade was aware that the steel industry exported one-third of its production and could export more. Mr. Thorneycroft said he was aware that crane manufacturers were having difficulties in obtaining their full requirements of steel from home production, as were other manufacturing industries, but the production of steel was increasing and direct exports of this material were being limited. There was a voluntary arrangement to restrict exports to the 1955 level and it had to be borne in mind that some of these exports were to United Kingdom companies overseas.

Electricity Board's Capital Expenditure

A number of questions were asked by Mr. G. Nabarro (Conservative) concerning capital expenditure by the North of Scotland Hydro-Electric Board and the South of Scotland Electricity Board during the present year. He desired to know the extent by which the expenditure of these Boards for inessential purposes had been reduced, following the announcement of the Government's economy policy in July last, and what the revised capital expenditure figures for this year were. In a supplementary question, he inquired if the Secretary of State for Scotland was aware that private-enterprise interests were being squeezed like an orange until the pips squeaked and he pressed for an assurance that the reduction of inessential expenditure by the Boards would be commensurate with the reduction by private enterprise.

Mr. J. Henderson Stewart, Joint Under-Secretary of State, replied that, in response to the Government's request, both Boards had offered to make cuts in the expenditure which they would otherwise have incurred in 1956 on distribution and miscellaneous matters, but that he was not yet able to give details. In reply to another question by Mr. Nabarro, the Under-Secretary of State said that, at December 31, 1955, the North of Scotland Hydro-Electric Board had spent £121 million on capital account. Regarding the Board's further commitments, it expected to incur capital expenditure amounting to about £18 million in 1956, but the precise amount had still to be settled.

Halting the Wages Spiral

In a written reply to Mr. P. Williams (Conservative), who asked the Prime Minister what further initiative he proposed to take with the leaders of industry to halt the present leap-frogging of wages, which, in turn, was causing inflation, Sir Anthony Eden said that there was more than one view of the causes of inflation. He intended to invite leading employers and trade unionists to have further talks with him and his colleagues after his return from his visit to President Eisenhower.

White Paper on Technical Education

In answer to questions by Mr. Albu and Mr. N. N. Dodds (Labour) regarding the facilities for technical education and proposals for the future development of technical colleges, Sir David Eccles, the Minister of Education, stated that the plans for technical education, which he and the Secretary of State for Scotland proposed to put into effect during the next five years, would be described in a White Paper. The Government intended to publish this document before the end of the present month.

Employees' Restrictive Practices

Captain H. B. Kerby (Conservative) asked the Minister of Labour and National Service whether he would set up a commission on similar lines to the Monopolies Commission to inquire into the restrictive practices of trade unions, in view of the fact that such practices by organised employees raised different problems from those caused by the restrictive practices of trade associations. Mr. Iain Macleod, the new Minister, replied in the negative. He said that the removal of obstacles to production was one aspect of the general problem of increasing industrial productivity. The matter was best dealt with by the two sides of the industries concerned.

Contributions to United Nations' Funds

Subject to parliamentary approval, Mr. A. D. Dodds-Parker, Joint Under-Secretary of State for Foreign Affairs, informed Mr. Fred W. Mulley (Labour), the Government proposed to contribute £800,000 to the United Nations Technical Assistance Programme for 1956. Careful consideration had been given to suggestions for increasing that amount, but the Government regretted that this was not possible in the present financial circumstances.

NOTICES OF MEETINGS

Association of Supervising Electrical Engineers

LONDON
"Electrostatic Precipitation," by S. Lawrie-Walker. West London Branch. Windsor Castle Hotel, 134 King-street, Hammersmith, W.6. Tues., Feb. 7, 7.30 p.m.
"Specialised Spot Welding," by C. G. Aldridge. South West London Branch. 32 Worple-road, Wimbledon, S.W.18. Wed., Feb. 8, 8.15 p.m.
LEEDS
Discussion on "Space Heating." Leeds Branch. Great Northern Hotel, Leeds. Mon., Feb. 6, 7.30 p.m.

British Institution of Radio Engineers

EDINBURGH
Film Evening. Scottish Section. Department of Natural Philosophy, The University, Edinburgh. Thurs., Feb. 9, 7 p.m.
WOLVERHAMPTON
"The Ionophone Loudspeaker," by A. E. Falkus. West Midlands Section. Wolverhampton and Staffordshire Technical College, Wulfruna-street, Wolverhampton. Wed., Feb. 8, 7.15 p.m.

British Welding Research Association

NOTTINGHAM
Symposium on "Increasing Production by Developments in Welding and Design Techniques." Mechanics' Institution, Trinity-square, Nottingham. Tues. and Wed., Feb. 7 and 8, 9.30 a.m. and 2.30 p.m.

Chemical Society

BRISTOL
"Recent Advances in Acetylene Chemistry," by Professor R. A. Raphael. Bristol Branch. Chemistry Department, The University, Bristol. Thurs., Feb. 9, 7 p.m.
EDINBURGH
"Organo-Metallic Co-ordination Compounds," by Professor G. E. Coates. Edinburgh Branch. Biochemistry Lecture Theatre, Teviot-place, Edinburgh. Tues., Feb. 7, 7 p.m.

Illuminating Engineering Society

LONDON
"Lighting at London Airport," by J. G. Holmes. Lighting Service Bureau, 2 Savoy-hill, W.C.2. Tues., Feb. 14, 6 p.m.

Incorporated Plant Engineers

LONDON
"Electronics in Industry," by J. E. Fielden. London Branch. Royal Society of Arts, John Adam-street, W.C.2. Tues., Feb. 7, 7 p.m.*

Institute of Fuel

EDINBURGH
"Smokeless-Fuel Production," by Lieut.-Colonel A. Vaughan Cowell. Scottish Section. North British Hotel, Edinburgh. Fri., Feb. 10, 7 p.m.

Institute of Marine Engineers

BIRMINGHAM
Annual meeting for members only, at 6.30 p.m. "Castings," by F. Buckley, at 7 p.m. West Midlands Section. Birmingham Exchange and Engineering Centre, Birmingham. Thurs., Feb. 9.
LIVERPOOL
"Marine Lubrication," by G. H. Clark. Merseyside and North Western Section. Riversdale Technical College, Liverpool. Wed., Feb. 8, 5.30 p.m.

Institute of Road Transport Engineers

LIVERPOOL
"Piston Design and Maintenance," by I. Howell. West Regional Centre. Adelphi Hotel, Liverpool. Thurs., Feb. 9, 7.30 p.m.

Institute of Welding

LONDON
"Welding Metallurgy and Electrode Development," by J. Mercer. South London Branch. Lighting Service Bureau, 2 Savoy-hill, W.C.2. Thurs., Feb. 9, 6.30 p.m.*

Institution of Chemical Engineers

LONDON
"Liquid Atomisation and the Drop Size of Sprays," by R. P. Fraser and P. Eisenklam. Geological Society, Burlington House, Piccadilly, W.1. Tues., Feb. 7, 5.30 p.m.

Institution of Civil Engineers

LONDON
"Some Hydraulic Investigations in Connection with Wadi Tharthar Project, Iraq," by A. R. Thomas. Hydraulics Division. 1 Great George-street, S.W.1. Tues., Feb. 7, 5.30 p.m.*
MANCHESTER
"Some Effects of Mining Subsidence," by C. E. Farran. North Western Association. Engineers' Club, Albert-square, Manchester. Thurs., Feb. 9, 6.30 p.m.
NOTTINGHAM
"Prestressed-Concrete Bridge Design," by A. Goldstein. Midlands Association. Mechanics' Institute, Trinity-square, Nottingham. Tues., Feb. 7, 6.15 p.m.*

Institution of Electrical Engineers

LONDON
Discussion on "What Should be Our National Fuel Policy?" opened by E. F. Schumacher. Savoy-place, Victoria-embankment, W.C.2. Mon., Feb. 6, 5.30 p.m.*
"Pulse Techniques, with Particular Reference to Line and Radio Communication," by Dr. Ing. E. M. Deloraine. Radio and Telecommunications Section. Savoy-place, Victoria-embankment, W.C.2. Wed., Feb. 8, 5.30 p.m.*
CHESTER
"A High-Power Mechanical Contact Rectifier," by Dr. J. C. Read and C. F. Gimson. Mersey and North Wales Centre. Town Hall, Chester. Mon., Feb. 6, 6.30 p.m.
LEEDS
"Measurement as a Factor in Understanding," by Dr. K. J. R. Wilkinson. North Midland Centre. 1 Whitehall-road, Leeds. Tues., Feb. 7, 6.30 p.m.*

Institution of Engineering Designers

LIVERPOOL
"Heat Pump," by K. Hall. Old Swan Technical College, Liverpool. Sat., Feb. 11, 10 a.m.

Institution of Engineering Inspection

LONDON
"Isotopes in Industry," by J. C. Rockley. Royal Society of Arts, John Adam-street, W.C.2. Wed., Feb. 8, 6.45 p.m.

Institution of Heating and Ventilating Engineers

MANCHESTER
"Process Control in Industry," by J. E. Fielden. Engineers' Club, Albert-square, Manchester. Fri., Feb. 10, 6.30 p.m.

Institution of Mechanical Engineers

LONDON
Discussion on "Instrumentation: Design, Accuracy and Layout." Steam Group. 1 Birdcage-walk, S.W.1. Tues., Feb. 7, 6.45 p.m.*
"Oil Flow and Film Extent in Complete Journal Bearings," by J. A. Cole and C. J. Hughes; "An Experimental Investigation into Stepped Thrust-Bearings," by R. C. R. Johnston and Dr. C. F. Kettleborough. Applied Mechanics Group. 1 Birdcage-walk, S.W.1. Fri., Feb. 10, 5.30 p.m.*

Institution of Production Engineers

LONDON
The 1955 Sir Alfred Herbert Paper: "Work Design and Training for Future Industrial Skills," by Dr. N. H. Mackworth. Royal Institution, Albemarle-street, W.1. Thurs., Feb. 9, 6 p.m.* (Admission by ticket.)
"Rubber Press Forming for Aircraft," by W. Thorn. London Graduate Section. 10 Chesterfield-street, W.1. Tues., Feb. 7, 7.15 p.m.

Junior Institution of Engineers

LONDON
"A Production Control System Incorporating an Electronic Computer," by W. J. Kease. Pepys House, 14 Rochester-row, S.W.1. Fri., Feb. 10, 7 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE-UPON-TYNE
"Bearings for Marine Geared Turbines," by A. D. Newman. Mining Institute, Newcastle-upon-Tyne. Fri., Feb. 10, 6.15 p.m.

Society of Engineers

LONDON
Presidential Address by Captain H. F. Jackson. Geological Society, Burlington House, Piccadilly, W.1. Mon., Feb. 6, 5.30 p.m.*

* An asterisk is placed where it is understood that tea is available prior to the time stated.

THE HUMAN ELEMENT

Union representation in the motor industry—Management, labour and capital pulling together—American salaries and a new Russian ministry—Real wages have dropped.

★ ★ ★

Motor Industry Council

The suggestion that a development council should be set up to co-ordinate production within the motor industry was made last week by shop stewards in Coventry. The meeting, which was convened by the local district committee of the Confederation of Shipbuilding and Engineering Unions, passed a number of resolutions censoring Government policy where it is having a restrictive effect on vehicle production.

Pressure for a national policy for the motor-vehicle industry is likely to grow, at least until the spring demand once more takes up the industry's full capacity. The existence of the National Advisory Council for the Motor Industry, which meets regularly under the chairmanship of a senior Board of Trade official, does not appear to have been referred to. The shop stewards' main concern is obviously the prevention of short-time working such as took place recently at Austin's, Rootes, and elsewhere. The implications of " co-ordinated production " for the industry as a whole are obvious enough: competition would effectively be eliminated, and the threat to full employment and continued expansion considerably increased. On the other hand there may well be scope for the representation of labour—whose voice is likely to catch the Government's ear even more than the voice of the manufacturer—on a national council.

★ ★ ★

Working in Harmony

More than 100 delegates from 12 nations assembled at Rome last week-end to begin an international conference on human relations in industry. Organised by the Italian Productivity Centre and the European Productivity Agency of O.E.E.C., the conference is intended to be an exchange of experience on industrial problems between representatives of management, trade unions and specialists in the social sciences.

Three committees and several working groups have been set up to examine practical problems of industrial relations and the contribution which scientific research has made, or can make, to their solution. The three committees are studying the effects of the structure and organisation of industrial undertakings, staff policies and practice, and problems at shop level. The conference is based on the conviction that management and labour can work in harmony along with capital. A conference of this kind is therefore a direct challenge to the Marxian doctrines of the Communists. It must not be forgotten, too, that it is also a challenge to some of the feudal ideas which still trammel industry in certain European countries.

★ ★ ★

The U.S. and the U.S.S.R.

Two recent news items from the U.S. and the U.S.S.R. are well worth comparing. An analysis of the earnings of executives—the most glittering top brass—in American industry shows that it is still possible to retire on one year's earnings in at least one country in the world. The highest paid executive—Mr. H. H. Curtice, president of General Motors—received the equivalent of £245,000 in 1954. The average earnings of 11 top executives of the Ford Motor Company exceeded £100,000 in 1955. Twenty companies paid their head man over 200,000 dols. a year and 80 companies at least 100,000 dols. These fabulous salaries reflect the premium placed on good management in what remains a highly competitive economy.

The news from Russia was of the formation of a Ministry of Automation—the first in any country—to be headed by an engineer, Mr. Lesechko, who has won his spurs in " investigating the best methods of supplanting manual labour." The new ministry is to work in close collaboration with the Ministry of Machine Building in tackling a vast programme of mechanisation under the new Five Year Plan. Half a million technicians now training in the application of automatic processes to a wide range of industries will be made available to the new ministry, it is reported.

Thus we see two vast industrial powers straining in parallel, by different methods, but towards the same goal: higher and still higher productivity.

★ ★ ★

Wages—1955 and Beyond

The cold statistics of the Ministry of Labour have a depressing message for the country as a whole: whatever advances there may have been in productivity there were precious few in living standards. Real wages—the amount of goods the pay packet can buy—fell ba[illegible] in the race against advancing prices. Du[illegible]g the year average food prices rose by 8 per [illegible]nt.; the cost of living index by 6 per cent. [illegible]welve million wage-earners won increases amou[illegible]ting to 7 per cent., the remaining 10 million o[illegible]so stayed as they were.

Since the present year began [illegible]more increases have been granted, the largest—and the most recent—being a 7 per cent. award to railwaymen. Engineering unions claim a 15 per cent. increase, at least two-thirds of which the employers will probably grant. Next month the National Coal Board are expected to make an offer to the miners. The building workers' employers have commissioned an independent investigation into the wage structure of their industry. Everywhere there is the same story of the pound buying less and less, and some leading industrialists have begun to lay the blame at the Government's door.

Price restraint, wage restraint, dividend restraint—whether voluntary or compulsory—are in themselves no cure for inflation. The only effective cure is abundance, and where labour is in short supply this means more machines and greater effort, not pegged-down wages or pegged-down cost of living.

Letters to the Editor

ATTRACTING RECRUITS

Policy of the Ironfounding Industry

SIR, It was encouraging to this Council to read the well-reasoned note in your issue of January 20, which puts very fairly both the difficulties confronting ironfounders and the spirit in which many of them are approaching the problem of recruitment.

The question, however, is not altogether one of informing the public of the industry's aims and activities. This is an important function of any industry claiming to be modern in outlook, but its objective should be wider than that of recruiting the different grades of employee. You really touch the heart of the matter in your concluding references to the scope of effort open to individual firms. The normal sources of recruitment available to an industry are the urban populations in the neighbourhood of the works. An imaginative and constructive approach by the local firm—an approach to the problem, if you like, that would apply the spirit, although necessarily not the method, of commercial competitiveness—is what is most needed, and this must come chiefly from the individual units in the industry.

It is with that outlook that this Council's Recruitment, Training and Education Committee is facing the ironfounders' problem. The Council and the Committee are keenly aware, in seeking the suffrages of youth, of the " advantage of looking very modern and scientific " and they would like to impress upon the boy hesitating at the choice of an industrial career that the ironfounding industry is rapidly developing new techniques which require a high level both of skill and scientific knowledge.

There is ample evidence that foundry managements are thinking out afresh their recruitment needs at all levels. The continuing shortage of craftsmen is recognised, but the nature of the craftsman's job in the foundry of to-morrow may differ in important respects from that of the past. Perhaps his skill may be utilised more effectively by concentrating it at those points in foundry operations where it is indispensable. Certainly the type of practical and theoretical training he needs is receiving growing attention, as also is the problem which the larger companies face in deciding what type of boy is best suited to foundry work. In the past, one suspects, it may have been the boy who did not meet the requirements of other trades who was selected for the foundry.

There is, too, a growing need for foundry engineers, though whether an orthodox apprenticeship in mechanical engineering is the best foundation for this work must for the time being remain an open question. Several companies which operate comprehensive student apprenticeship schemes are making special efforts to steer more of their promising engineering apprentices into the foundry, at a stage in their training when they have come to appreciate the dependence of other departments on the foundry's products.

It may interest your readers, incidentally, to know that one very important part of the work to be done in stimulating a more imaginative approach to recruitment is to emphasise the opportunities of graduate training in foundry work offered by the National Foundry College, and of supplementary craft training for apprentices at the National Foundry Craft Training Centre. Both these organisations are models of their kind, and so far the potentialities of neither have been fully developed.

You, Sir, may be sure that much greater effort is now being devoted by the industry in the drive to recruit future managers, technicians and craftsmen. The industry is well aware of its own fundamental importance to engineers, to which you rightly refer; appreciation of this fact is one of the most powerful motives in our educational work.

Yours faithfully,

JOHN COLLETT,
Training Officer.

The Council of Ironfoundry Associations,
14 Pall Mall,
London, S.W.1.
January 23, 1956.

★ ★ ★

CORRECTING LETTER

SIR, Please allow me, as an Austro-Britisher, to be a bit amused about your note on page 874 of December 30, 1955. There you write under " Machinen—not Machines " about the importance of sending brochures to Austria dealing with " Machinen " instead of " machines." Actually the word " Machinen " does not exist in the German language. The only similar word is " Machinationen," which means intrigues. Of course you mean " Maschinen." I hope you do not mind this observation to your otherwise very pleasant note.

Yours faithfully,

F. [illegible] POLLOK.

Stevenston,
Ayrshire.
January 18, 1956.

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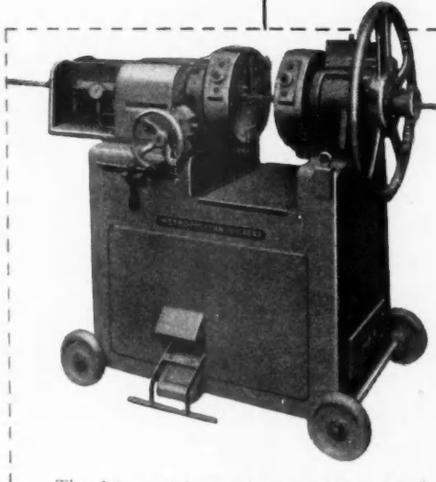

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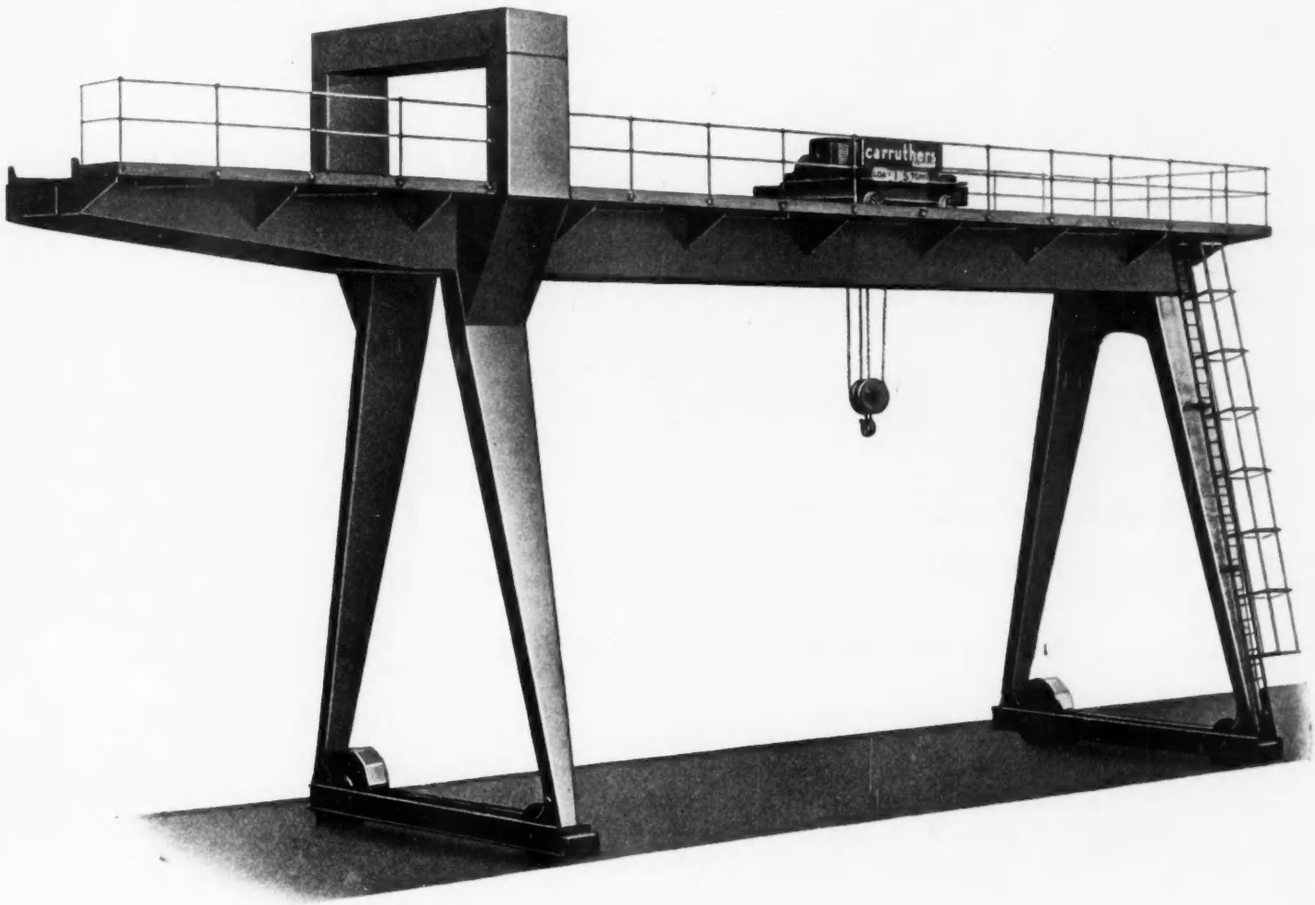

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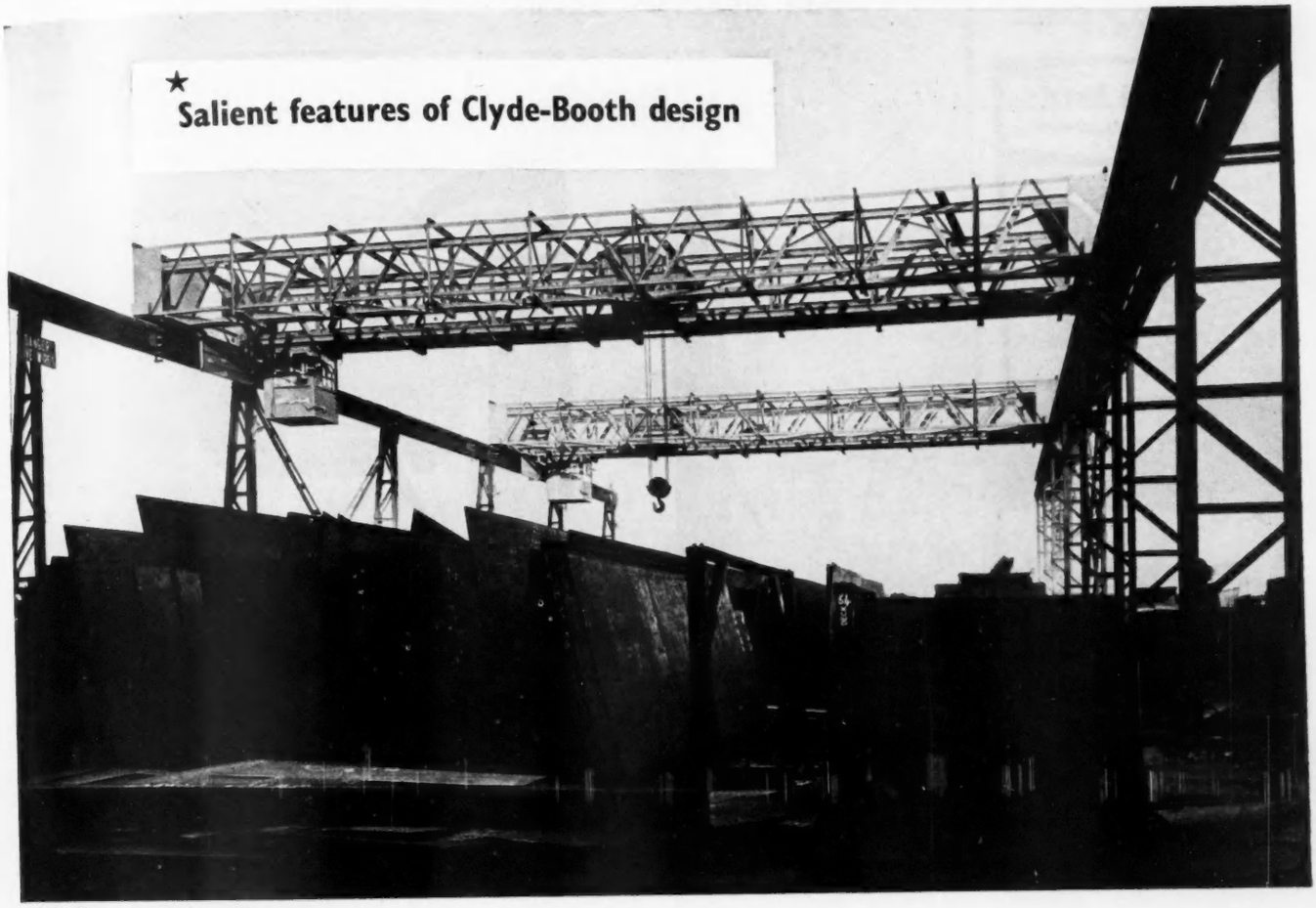

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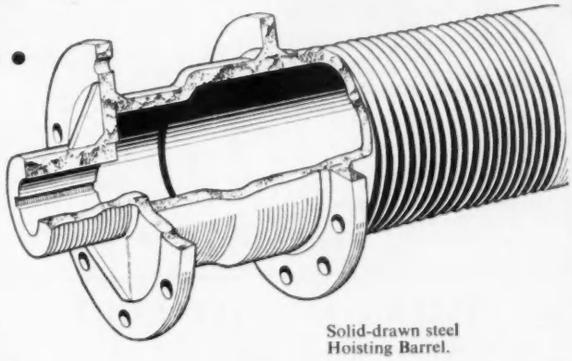

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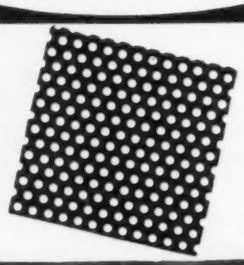

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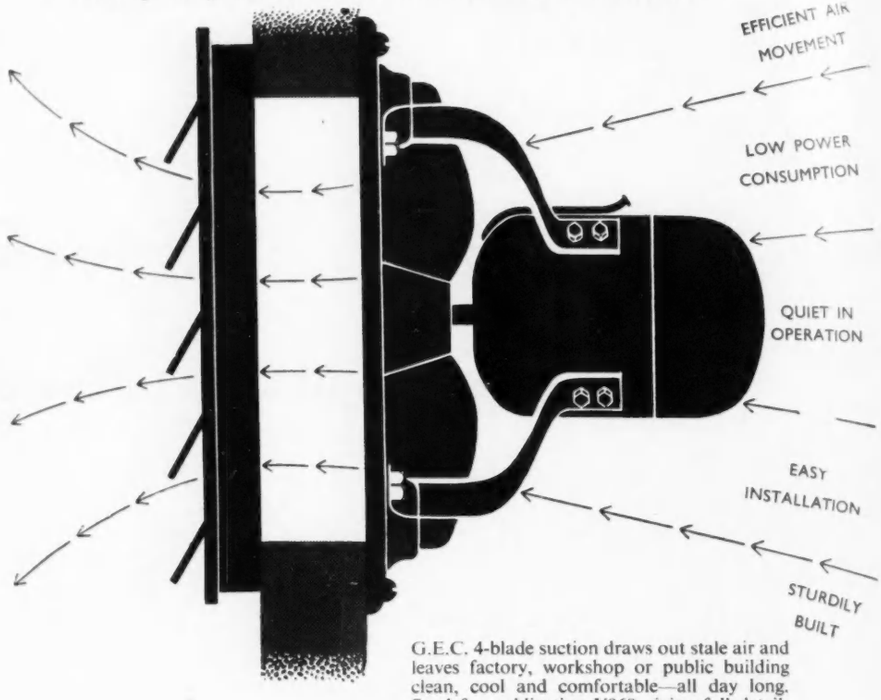

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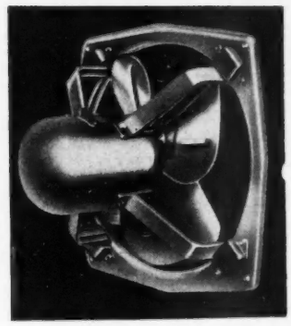

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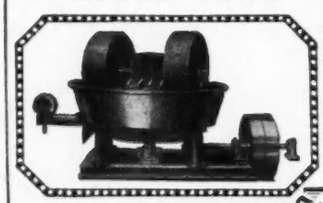

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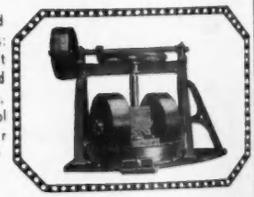

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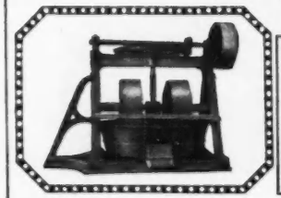

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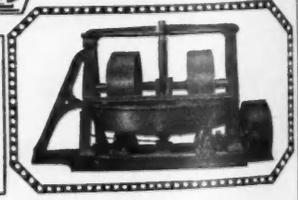

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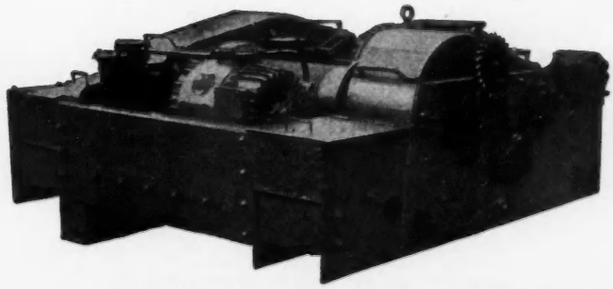

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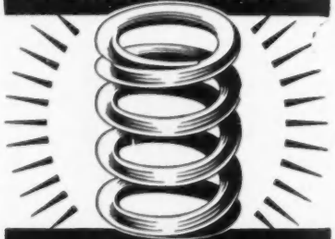

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to a .. CROWTHORN

Say Kennedy & Kempe Ltd.

Messrs. Kennedy & Kempe Ltd., of Andover, have never regretted choosing Crowthorn lathes, finding them to be as versatile as they are efficient.
Five Crowthorn lathes, two 7½in. centre by 8ft. 3in. gap bed, one 10½in. centre by 15ft. gap bed and two 12in. centres by 15ft. 3in. gap bed lathes are engaged on production work and general machining. The widely varying nature of the jobs means that the bigger lathes are often called upon for close tolerance light boring and turning, as well as for machining rolls, axles and other work, more in keeping with their size.
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KENNEDY & KEMPE LTD
ENGINEERS
HAREWOOD FOREST WORKS
LONGPARISH, ANDOVER, HANTS

13th February, 1956

The Southern Engineering & Machinery Co.,
133, Millbrook Road,
SOUTHAMPTON.

Dear Sirs,

CROWTHORN LATHES

We have pleasure in enclosing some photographs of our Crowthorn lathes which we think may be of interest to you.

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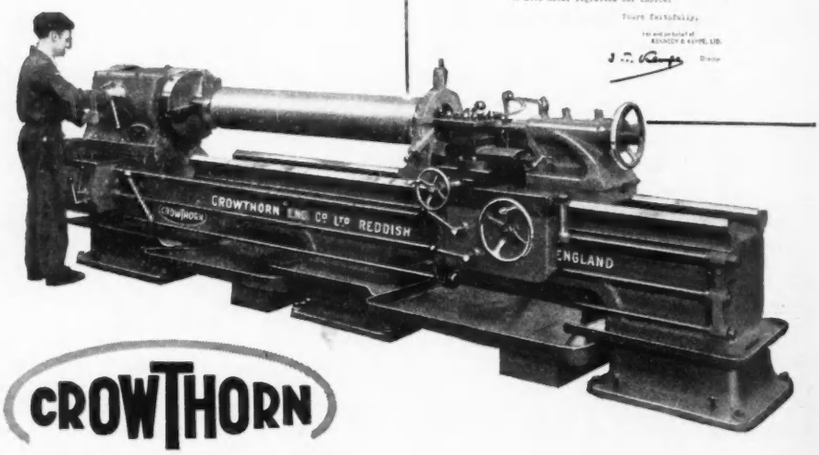
All work seems to come alike to the Crowthorn, we have never regretted our choice.

Yours faithfully,

for and on behalf of
KENNEDY & KEMPE, LTD.

J. T. [illegible] Director



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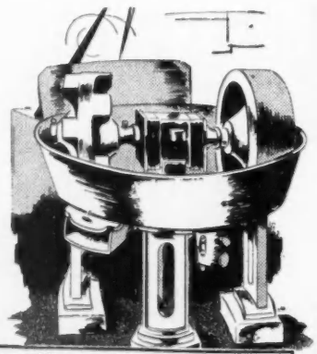
CL 68

'FULBOND'
works perfectly
in a simple mill
like this...



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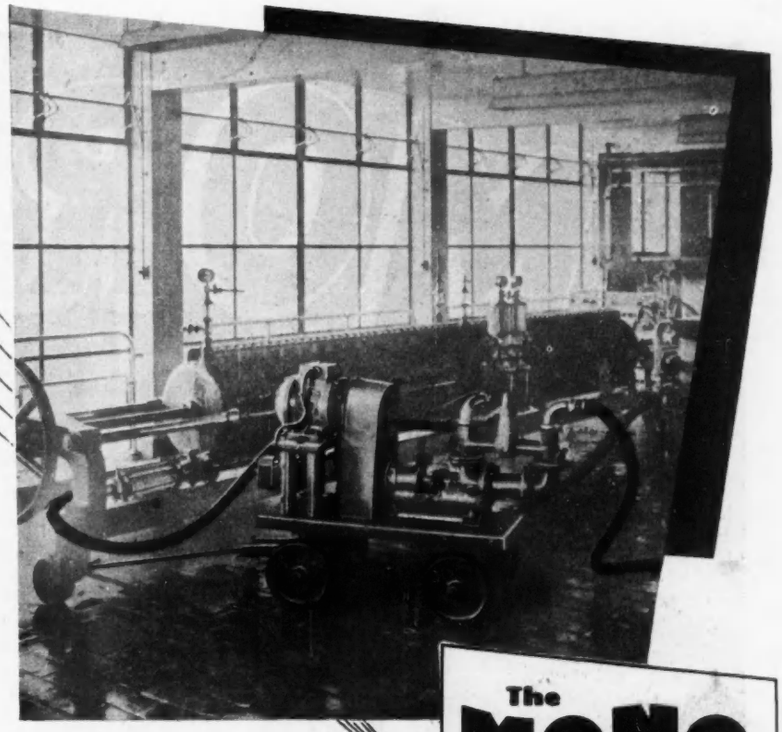

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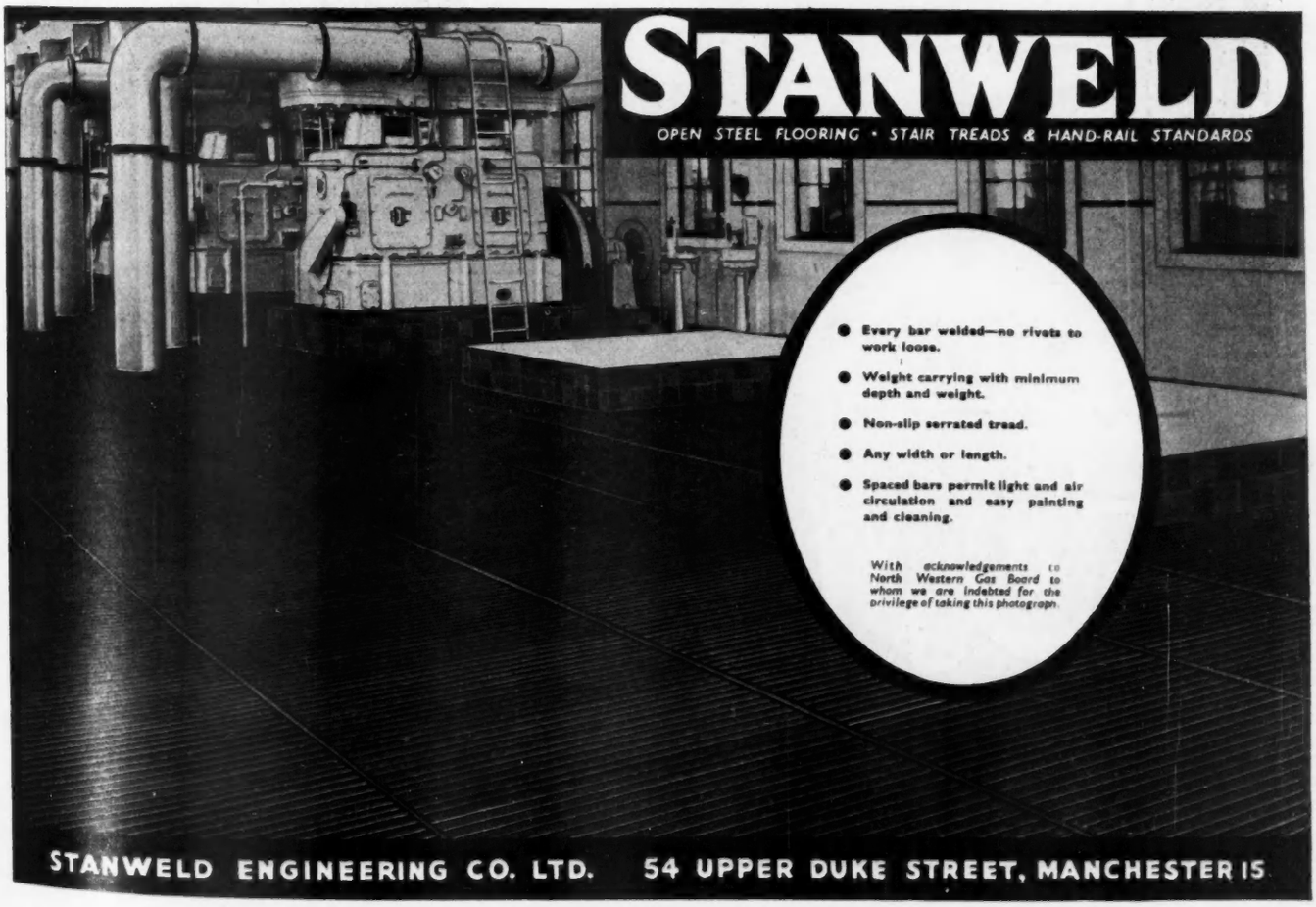

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- Any width or length.
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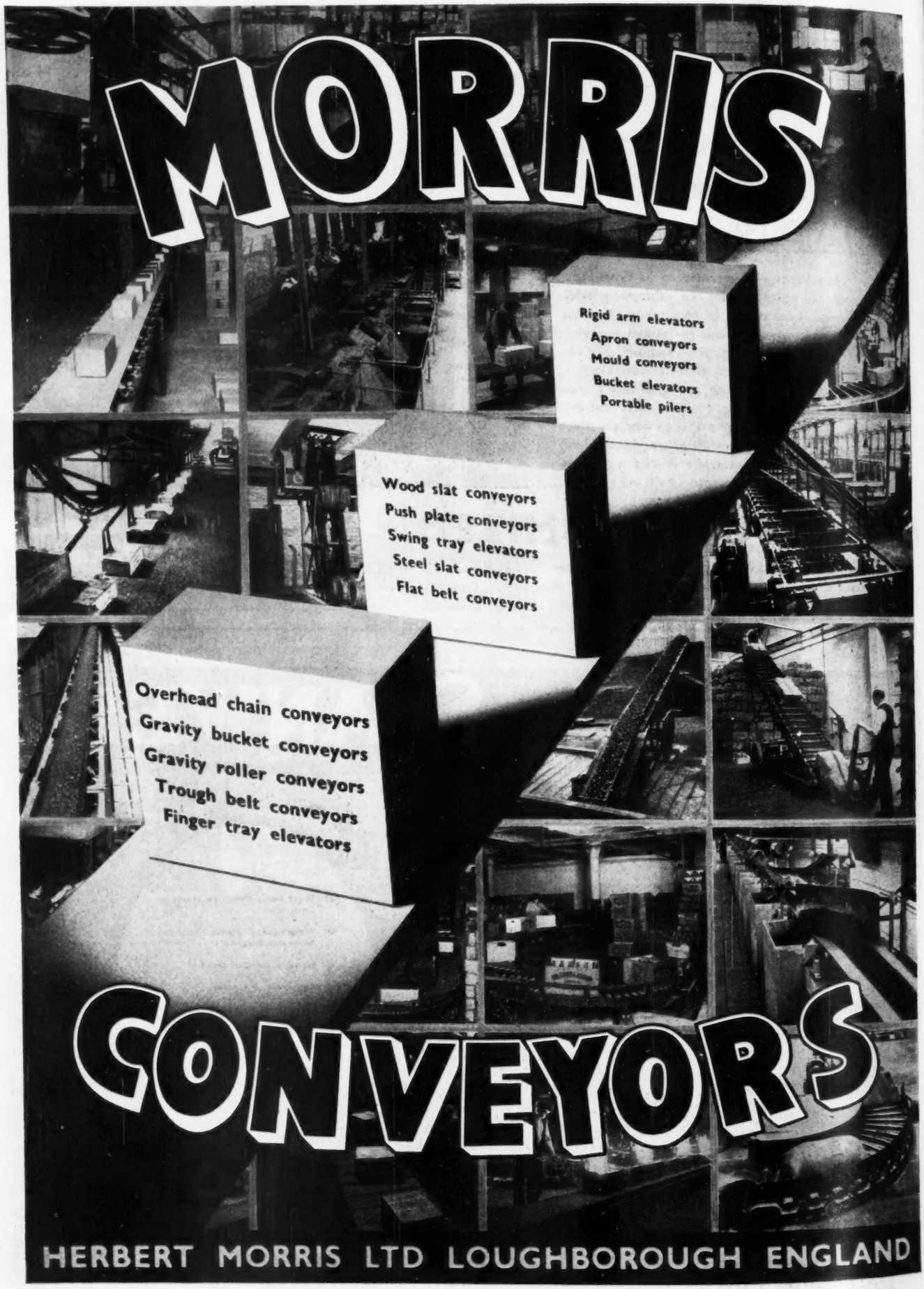
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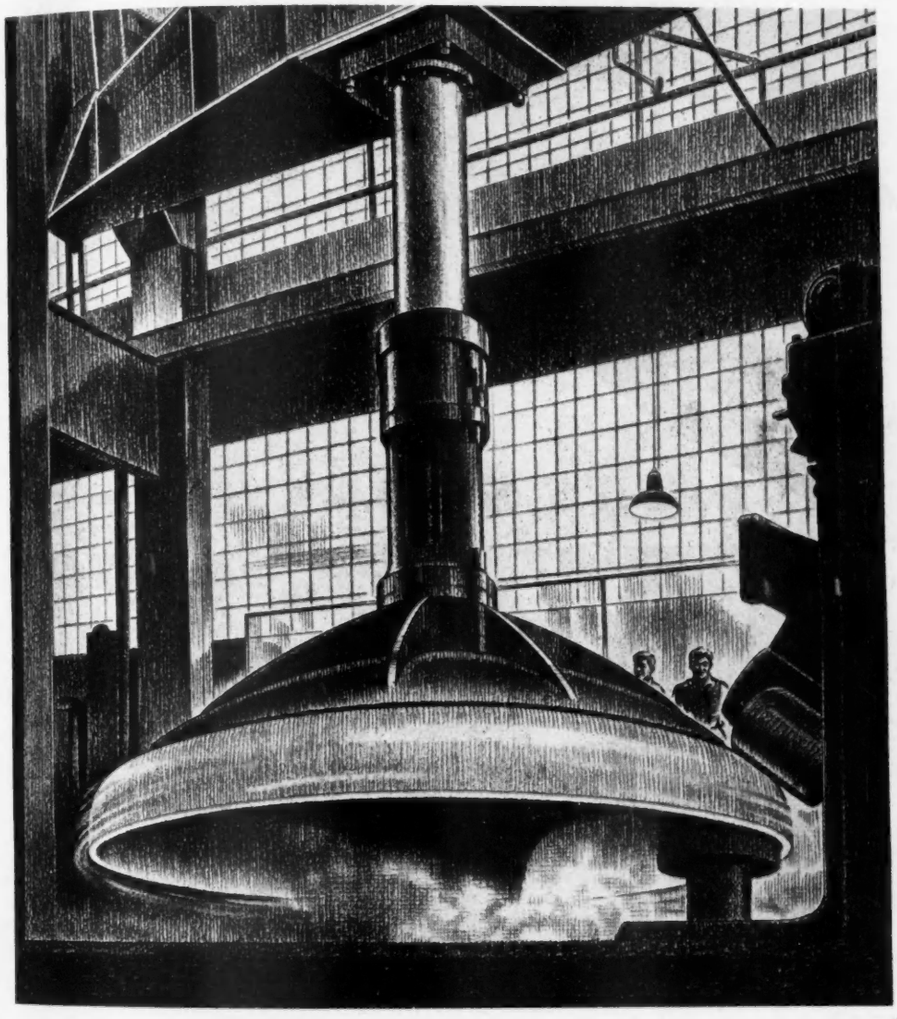

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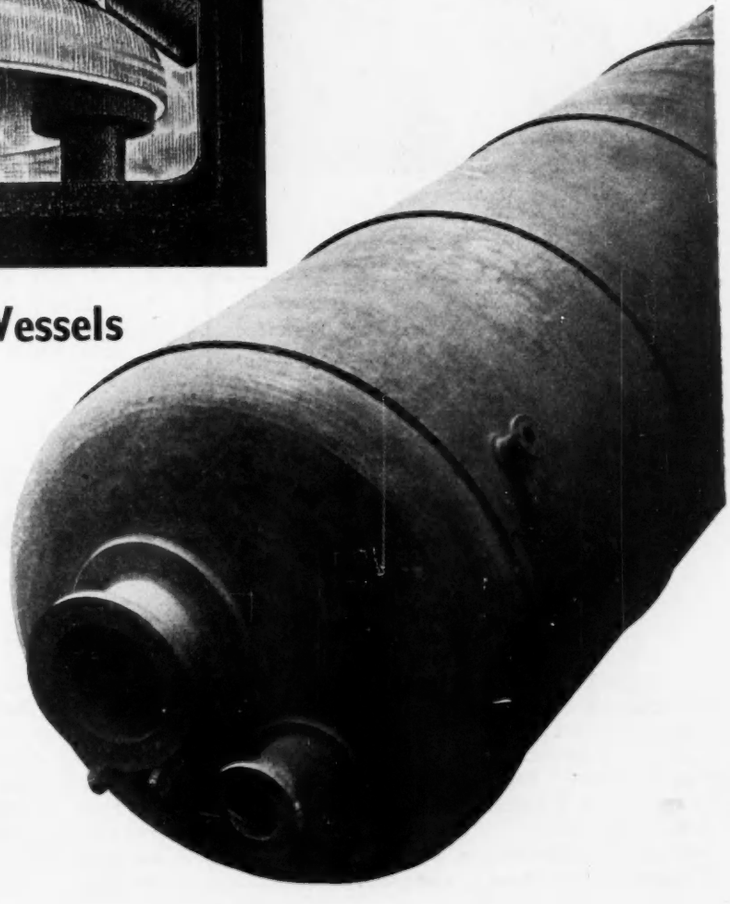

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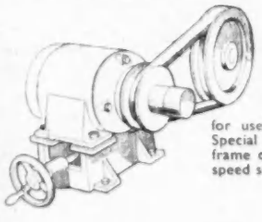

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A Print for Industry Ltd. Advertisement

Classified Advertisements continued from Page 7

MECHANICAL ENGINEERING GRADUATE required by the Works Division of an organisation manufacturing heavy capital equipment for the steel, gas, chemical and petroleum industries. The man appointed will undergo a period of training on the staff of the various works departments prior to assuming a responsible position in the Company. Applications should contain details of education and previous industrial experience.—BOX K 193, Offices of ENGINEERING.

A NUMBER OF DESIGNERS are required for good class mechanical engineering work by HEENAN & FROUDE, LIMITED, WORCESTER. Applicants should be between the ages of about 25 and 40. Please state education, training, experience and salary required; special consideration to men with outstanding experience and qualifications. Those used to marine, medium and heavy engine design would be particularly suitable. Pension scheme, attractive surroundings, and usual staff amenities. Assistance with housing and removal expenses if necessary. Please address your application for the attention of MR. T. SALTER. K 196

ASSISTANT PLANT ENGINEER (H.N.C. OR HIGHER STANDARD) required for Bank of England Printing Works, Old Street, E.C.1, in process of moving to Debden, Loughton, Essex. To be responsible under the Plant Engineer for the running and maintenance of all services including generation of electricity (turbines and diesels), Plenum and radiation heating (oil fired), etc., also all production machinery. Permanent pensionable post at a starting salary up to £1100. House purchase facilities are available. Candidates should be British by birth and under age 35.—Write stating age, details of education, qualifications and experience to STAFF MANAGER, ST. LUKE'S PRINTING WORKS (BANK OF ENGLAND), OLD STREET, E.C.1. K 199

ASSISTANT WORKS MANAGER required by British-managed Structural and Mechanical manufacturing Engineering Company in India which possesses Structural Steelwork Shops, Welding Shops, Iron Foundry, Machine and Smith Shops. Must be trained in modern manufacturing methods and works organisation and control. Four-year agreement with renewal clause. Selected candidate will be interviewed in London, expenses paid.—Write, giving full particulars of training and experience to BOX Z.D.572, DEACON'S ADVERTISING AGENCY, 36, LEADENHALL STREET, LONDON, E.C.3. K 245

PIPING DRAUGHTSMEN required by ASHMORE, BENSON, PEASE & COMPANY, STOCKTON-ON-TEES, experienced in the layout and detailing of requisite pipework for Chemical, Gas, Oil and similar type work. Maximum assistance given in obtaining accommodation. Appointments are permanent by firm where Pension Scheme, Technical Library, Sports and Social facilities have long been in operation.—Apply stating age, experience, etc., quoting Ref. P.F. K 175

THE BRITISH PETROLEUM COMPANY, LIMITED, has immediate vacancies for **CHEMISTS, PHYSICISTS, CHEMICAL ENGINEERS AND MECHANICAL ENGINEERS** for work in their United Kingdom Refineries and at their Research Station at Sunbury-on-Thames. Applications are invited from men with University degrees or equivalent qualifications and who have fulfilled National Service obligations. Previous industrial experience desirable but not essential. Age preferably not above 33. Salaries within the range £650-£1300 according to qualifications and experience. Excellent working conditions. Non-contributory Pension Scheme.—Write, giving 565 details quoting H.3297 to BOX 8580, c/o full, GRESHAM HOUSE, E.C.2. G 565

DESIGNER DRAUGHTSMAN required by Kuwait Oil Company in Civil Engineering Division, London Office, for design work covering industrial, structural and maritime engineering, water services and sewerage disposal, and undertake normal work of C.E. Drawing Office. Knowledge of building construction will be advantageous. Age 30-50. Matriculation or equivalent standard of General Education, with membership of Institution of either Civil, Structural, or Municipal Engineers. Commensurate salary in accordance with experience and qualifications. Non-contributory Pension Scheme and Luncheon Vouchers.—Write for application form to L.O.218, BOX X/188, c/o 191, GRESHAM HOUSE, E.C.2. K 247

ARMSTRONG SIDDELEY MOTORS have vacancies for both

SENIOR AND JUNIOR ENGINEERS

for investigation of vibration problems on gas turbine development engines. Degree or H.N.C. in Mechanical Engineering or Electrical Engineering essential. Electrical Engineers should have some mechanical engineering experience. Applicants must be capable of using necessary recording equipment. Salaries commensurate with qualifications and experience, together with good pension scheme. —Applications to REFERENCE CG/VP, TECHNICAL PERSONNEL MANAGER, ARMSTRONG SIDDELEY MOTORS, COVENTRY. G 621

ASSISTANT MACHINE SHOP FOREMAN required by large Structural and Medium/Heavy Mechanical manufacturing engineering company in India which possesses structural steelwork shops and welding shops, iron foundry, machine and smith shops. Some fitting shop experience an advantage. Four-year agreement with renewal clause.—Write stating age and give full particulars of training and experience, to Z.Z.568, DEACON'S ADVERTISING AGENCY, 36, LEADENHALL STREET, LONDON, E.C.3. K 244

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SENIOR DRAUGHTSMAN required for makers of Machine Tools and Sheet Metal Machines.—Apply with age, experience, salary, etc., to F. J. EDWARDS LTD., 359, EUSTON ROAD, LONDON, N.W.1. K 203

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Applications are invited for an **INTERESTING POSITION IN THE TECHNICAL INFORMATION SERVICE** of the Furniture Development Council, to edit publications, prepare abstracts and collaborate in the general enquiry service. Scientific or technical qualifications or suitable experience essential.—Apply to DIRECTOR, F.D.C., 11, ADELPHI TERRACE, LONDON, W.C.2. K 183

MECHANICAL DRAUGHTSMAN AND DESIGNER required by large Structural and Medium/Heavy Mechanical manufacturing engineering company in India which possesses structural steelwork shops and welding shops, iron foundry, machine and smith shops. Four-year agreement with renewal clause.—Write, stating age and give full particulars of training and experience, to BOX Z.A.569, DEACON'S ADVERTISING, 36, LEADENHALL STREET, LONDON, E.C.3. K 243

DEVELOPMENT ENGINEER required for factory in South-East Scotland, engaged in the manufacture of wire, wire rope and steel products, preferably with University Degree or equivalent qualifications in Mechanical Engineering. Age between 25 and 30. Superannuation scheme and canteen facilities available. State age and salary expected.—BOX K 200, Offices of ENGINEERING.

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DRAUGHTSMAN FOR MAINTENANCE AND DEVELOPMENT of Seamless Steel Tube Plant. Heavy engineering and Hydraulic experience desirable. Five-day week. Permanent pensionable position to suitable applicant. Special rate will be paid to man of high ability and qualifications.—Write stating full particulars to the CHIEF ENGINEER, STEWARTS and LLOYDS, LIMITED, BROMFORD TUBE WORKS, WHEELWRIGHT ROAD, ERDINGTON, BIRMINGHAM, 24. K 185

Required urgently by International Group for service at oil refinery in the MIDDLE EAST :—

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Age 30/45 in each case. Applicants should have Higher National Certificate or equivalent, Board of Trade Certificate (endorsed respectively for diesel and steam), or equivalent examination in the Institute of Marine Engineers. Should also have had 7/10 years' experience (including 5/6 years in responsible charge), in the operation and maintenance of, respectively, (*a*) Internal Combustion Engines from 20/450 h.p., and (*b*) Marine Steam Engines. An ex-E.R.A. (Diesel/Steam) might suit, depending on experience. Two-year tour involved in the first instance and substantial salary payable. Married accommodation and free family passages available. —Write, asking for application form and giving brief details of age, career, etc., to BOX E.618, c/o 191, GRESHAM HOUSE, E.C.2. K 170

DRAUGHTSMEN (SENIOR AND JUNIOR) required for work in connection with the following branches of Coke Oven and Gasworks plants.

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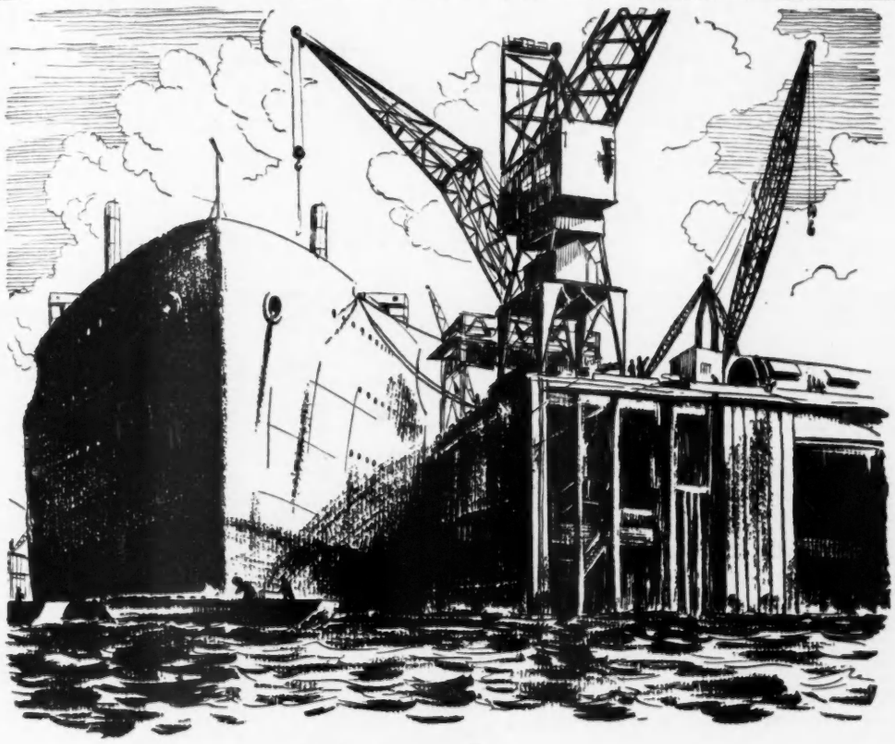
MECHANICAL MAINTENANCE ENGINEER required for a medium-sized plant in Yorkshire. Experience of preventative maintenance schemes and installation of plant desirable. Applicants please state age, experience, qualifications, and salary required.—BOX K 103, Offices of ENGINEERING.

QUASI-ARC LIMITED, BILSTON, STAFFS, has vacancies for

DEVELOPMENT ENGINEERS in its Welding Research Department. Applicants, who should possess Higher National Certificate in Electrical and/or Mechanical Engineering, will on appointment join a highly qualified team of research workers engaged in the development of different methods of automatic arc welding. Attractive salaries commensurate with age and experience will be paid. Five-day week. Pension Fund.—Apply in writing to the company quoting reference CL.5. K 248

Classified Advertisements continued on Page 32



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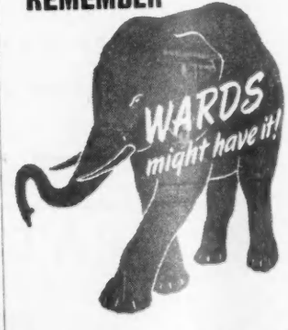

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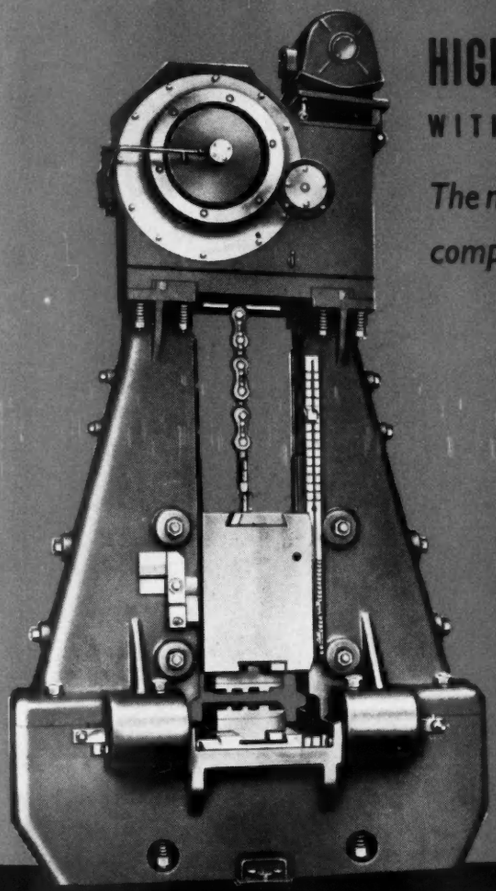

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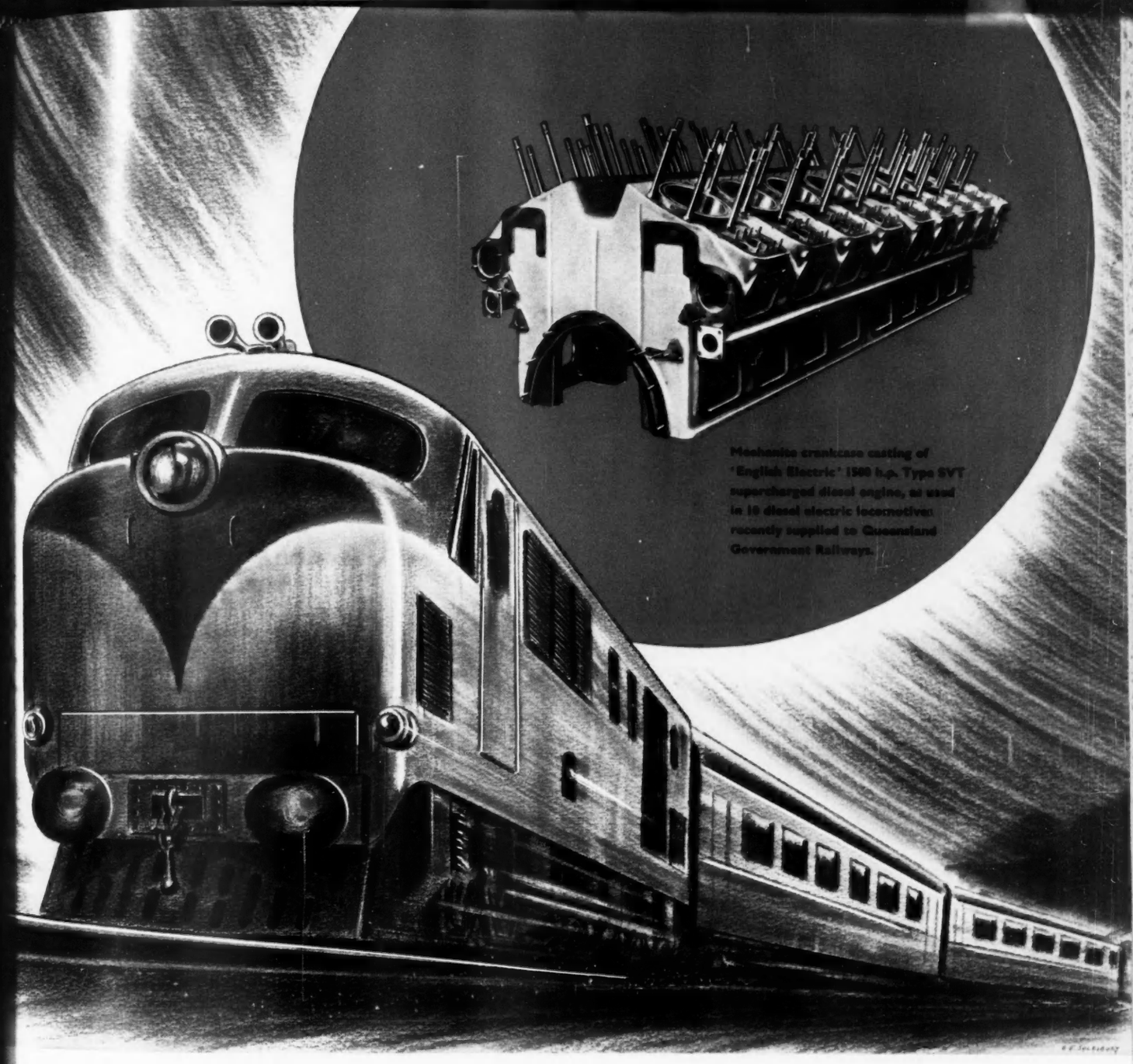
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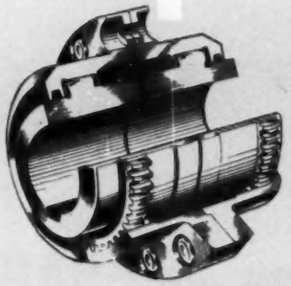

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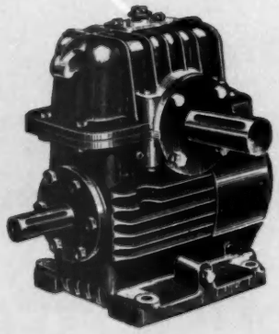

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